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PROJECTS FOR THE COMPLETION OF THE PANAMA CANAL.

THE newspapers have recently announced the formation of a new company, headed by Mr. Hielard, vice-president of the Chamber of Commerce, and the object of which is the completion of the work on the Panama Canal. As might have been expected, this news has been received with a mixture of curiosity and skepticism by the bearers of titles, discouraged by the failure of the petitions that they have vainly addressed to the public powers with a view to obtaining the official protection and aid that appeared to them necessary for protecting the numerous interests engaged in this affair.

The new company will, therefore, have hard work to restore the confidence of the public and to convince it of the possible success of this gigantic enterprise, which now numbers as many detractors as it lately had warm partisans.

What are the company's projects? We do not know. Perhaps it has not yet definitely decided upon the programme that will permit it to successfully complete the interrupted work.

It must be confessed, moreover, that the choice between the various projects proposed during the last two years appears to be pretty difficult.

Every one knows that the main difficulty of the enterprise resides in the piercing of the Culebra, which forms part of the Cordillera, and which the axis of the canal meets at its lowest point, at 100 meters above the level of the sea.

The work done in this portion of the line, which includes a length of 1,900 meters, has sensibly lowered this level, and the mean height of the plateau does not exceed 75 meters. The impossibility of removing this huge mass for constructing the dead canal first projected is admitted by all the engineers who have studied the question, and who are unanimous in recognizing the fact that a lock canal alone will permit of practically solving the problem. It is, moreover, the solution that the company finally decided upon.

But where opinions begin to differ is on the manner of constructing such canal. Three projects merit attention: that of the company, that of the committee of studies appointed by the liquidator after the arrest of the work, and that of Mr. Bunau Varilla. The canal company's project comprises the establishment of an upper reach at the level 40, supplied by an artificial lake created by the damming of the Chagres in the Gamboa valley. The level of the water in this lake would vary between 30 and 34 meters. It would, therefore, be necessary, in order to raise the water to the level 49 (the maximum level in the upper reach), to have recourse to pumping engines. As for the excess of water furnished by the Chagres, as well as that derived from the numerous lower affluents, they would be led to the sea by a series of derivations forming, in a manner, two other canals, parallel with the maritime canal.

We shall not dwell upon the construction and location of the various locks, for which there were naturally selected as many of the rocky parts as possible, where the sides of the cutting are sufficiently stable to render it useless to construct walls, the masonry work being thus reduced to the construction of the crowns of the locks. This consideration is of the greatest importance in a country where such work would be very expensive, and could not be carried on rapidly by reason of the difficulty of finding special workmen.

The committee of studies took exception to the idea of installing pumping engines to feed the upper reach. Its project includes the creation, at the level 25, of an immense artificial lake, fed by the Chagres, and extending from kilometer 37 to kilometer 57, confined at its two extremities by dams at 40 meters above the level of the sea.

On the Atlantic side a second dam, situated at kilometer 24, would constitute a second lake receiving the water of the first, and in which the level would be at 16 meters above that of the sea. At this latter dam would begin the maritime canal, descending to Colon by two locks, and the derivations designed to lead to the sea the overflow of the lakes and the lower affluents of the Chagres. This project naturally includes the digging out of the Culebra to the level 25; that is to say, to a depth greater by 15 meters than that anticipated in the company's project.

Mr. Bunau Varilla's project takes for the height of the upper reach the same level as the company's, but, instead of damming the valley of the Chagres, it admits the river freely into the canal, in creating an artificial lake maintained by a dam situated at kilometer 24, and in which the level of the water would vary between 16 and 19 meters. As in the company's project, the upper reach would be fed by pumping engines taking water from the said lake, the overflow of which would run to the sea through a canal, formed for the greater part of its length by the present bed of the Chagres.

The duration of the work for these various projects varies between six and eight years, and the cost is estimated at about six million francs.

It remains for us to say a few words about a project very recently presented by Mr. Malgarini, and which appears as if it ought to attract attention from the standpoint of novelty and originality of the methods of execution, as well as for the saving in time and money that would result from its adoption.

The author, who has resided on the isthmus, has noted the difficulty spoken of above, of finding workmen on the spot for the establishment of masonry locks such as are constructed in our country. He thinks this difficulty may be overcome by employing for the construction of the walls of the canal and locks an agglomeration of cement, which he calls calcareous sidero-monolith, and which is obtained as follows:

In the first place, a lattice is formed with irons of a thickness calculated according to the importance of the work and the resistance that it is desired to give. These irons are united with each other by annealed iron or brass wire. The frame, when finished, is put in place at once. Two plank partitions are arranged on each side and at a distance corresponding to the thickness that it is desired to give the walls. Into the space between these is poured a mixture of cement, sand, gravel, hydraulic lime, and dust of crushed stone. There is thus obtained a calcareous monolith in which the iron frame is completely embedded and which is capable of resisting pressures at least equal to those that would be supported by the best materials of construction. It will be understood that ordinary helpers, directed by an intelligent workman, can easily execute this work with a rapidity much greater than could be attained in masonry work, even with skillful workmen.

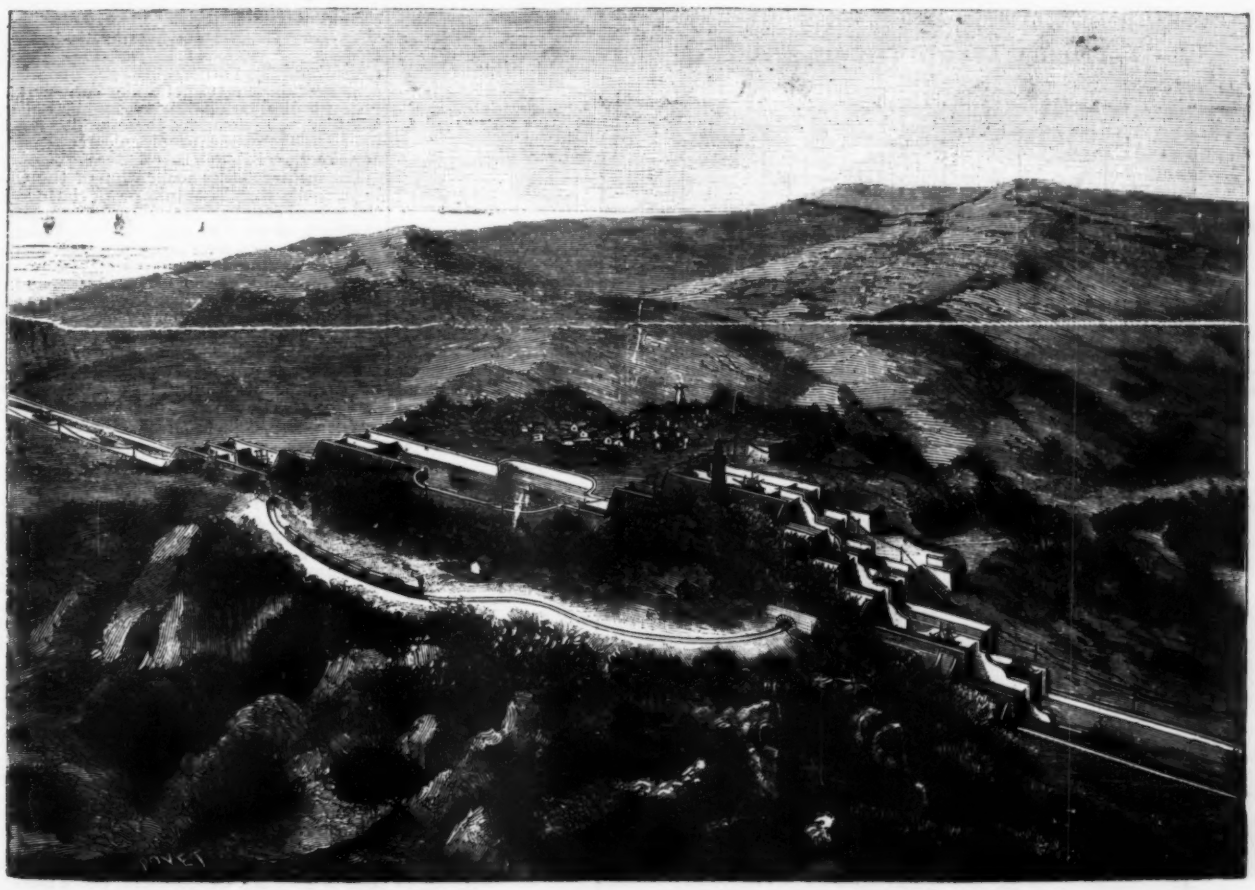


FIG. 1.—MR. MALGARINI'S PROJECT FOR COMPLETING THE PANAMA CANAL.

Fig. 1 gives a general view of the canal according to this project. Upon the Pacific slope there would be five locks, and upon the Atlantic slope nine, of which the first three are only represented in the engraving.

The length of the reaches is very variable. This is due to the fact that the author of the project has made it a special point to utilize in its present state the earthwork already executed.

The locks have an effective length of 180 meters with a mean fall of 12 and a width of 20 meters, in order to utilize the large amount of material stored on the isthmus by the Eiffel enterprise. They have double chambers, in order to permit of the simultaneous passage of boats going in opposite directions. In order to reduce the consumption of water as much as possible, Mr. Malgarini has devised a system of gates that permits of employing the water of the downstream chamber for the partial filling of the upstream one.

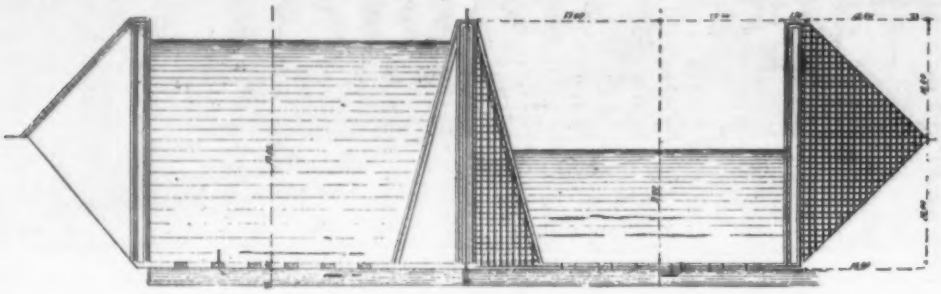


FIG. 2.—PROFILE CROSSWISE OF A LOCK CHAMBER.

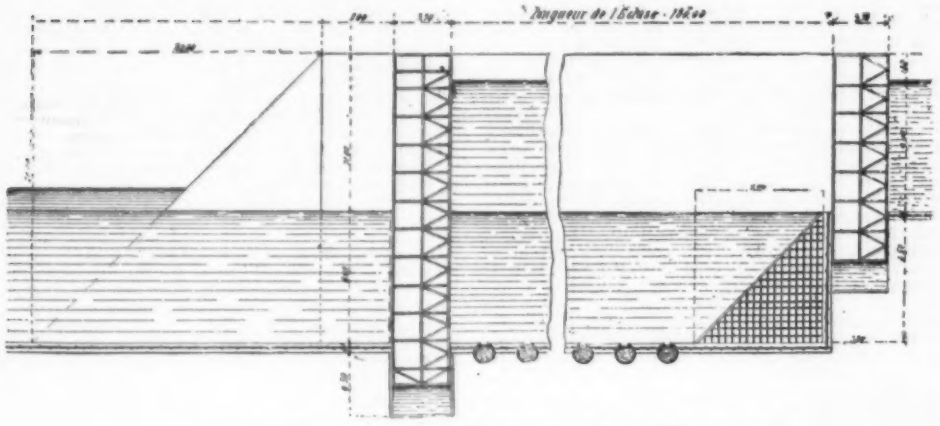


FIG. 3.—PROFILE LENGTHWISE OF A LOCK CHAMBER.

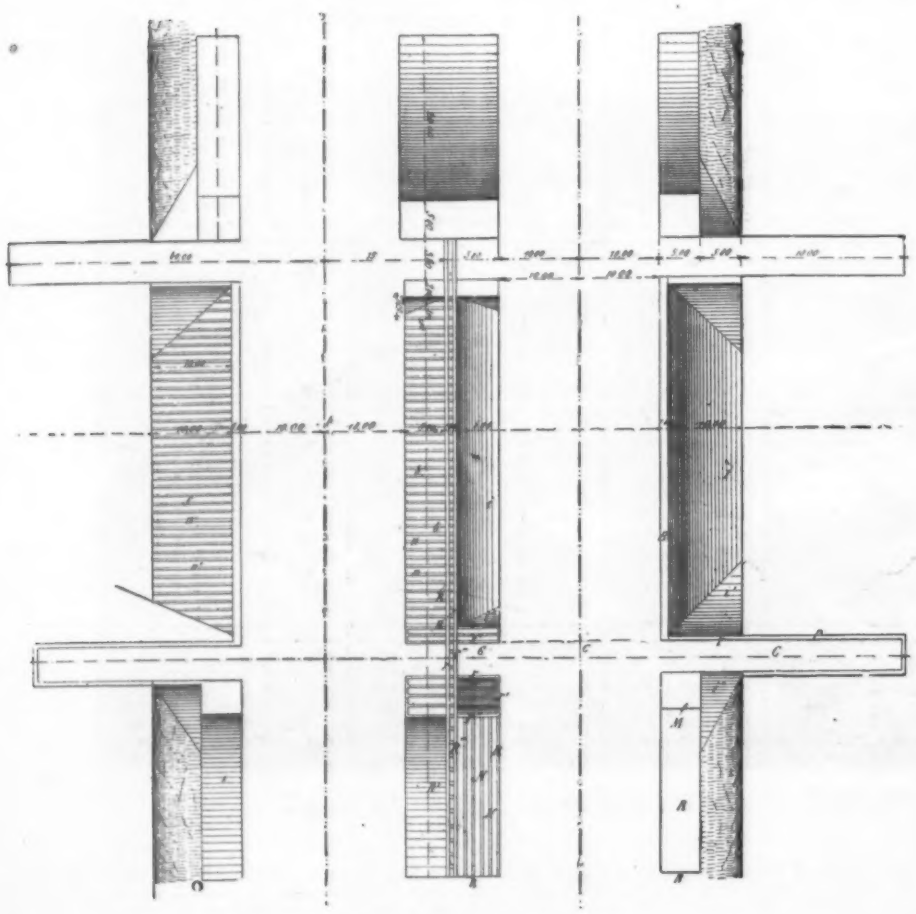


FIG. 4.—PLAN OF A LOCK.

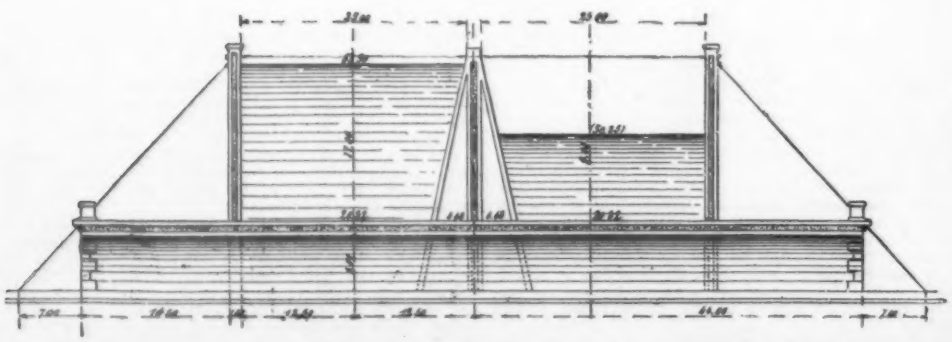


FIG. 5.—PROFILE LENGTHWISE OF THE TUNNEL OF THE PANAMA RAILROAD.

The width of the plane of water of the different reaches varies from 58 to 100 meters, according to the inclination of the existing embankments. It is sufficient to permit of the crossing of two ships, and the system, as a whole, therefore constitutes a true two-way canal.

The upper reach, situated at the present 73 level, would be fed by means of a reservoir formed by the damming of a river at a level a little higher than that of the reach. This river, the Obispo, is one of the principal affluents of the Chagres. Its discharge is more than sufficient to fill the canal, even admitting for the traffic the possible maximum. The dam would be established at the level 85, and in plan would have the form of a semicircle resting on each side against the mountains that inclose the bed of the river.

The height of the work would be 20 meters, and the level of the water would be kept at 85 meters, say 1 meter above the maximum level in the upper reach, the excess being carried off by a sluice.

The water would be led into the canal by a cylindrical conduit, 5 meters in diameter, constructed of the same kind of materials as the canal itself.

The direction line of the canal, as well known, twice intersects the Panama Railroad. In the other projects,

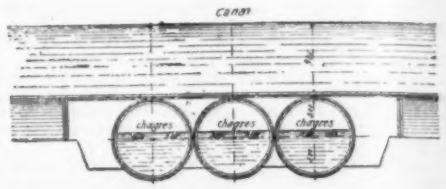


FIG. 6.—PROFILE CROSSWISE OF THE AQUEDUCTS OF THE CHAGRES RIVER.

the first passage, at San Pablo (kilometer 37), is effected through a swinging bridge, the material for which is already stored away on the isthmus. The second passage is avoided by works of deviation of the very costly line. In the project under consideration, the first of these works remains as it was originally conceived. The other works are avoided through the construction of a tunnel under the canal.

As for the various rivers intersected by the direction line, the passage of these under the canal would be effected by means of calcareous sidero-monolith aqueducts.

The author makes no mention of the Chagres; but it is probable that he thinks of deviating it by utilizing the lateral canal proposed by the company, and a part of which, as we have said, is already constructed.

As the project does away with the deepening of the Culebra cutting, it would permit of immediately beginning the construction of the locks, and, according to the author, would reduce to three years and 300,000,000 francs the time and money necessary to complete the canal. At all events, it merits being taken into serious consideration as regards the execution of the upper reach, where, for the construction of the locks, there are not at one's disposal those rocky masses that we have already spoken of, so that very important masonry work would be necessary at this point.

CENTRAL SCREW STEAMERS.

WHILE the discussions are going on concerning Paris as a seaport, some interesting experiments are still being made on the subject of the ascent of the Seine by ocean vessels. Let us recall that, among the vessels that have been seen at Paris at intervals are the Paris-Port de Mer, a small three master built especially for ascending the river, and which was wrecked upon the coast of Brazil; the Frigorifique, which arrived from La Plata in 1878, and remained for some time opposite the Trocadero and the Court of Justice; the Volage, a schooner yacht, which, in 1889, anchored in front of the Champ de Mars; and, more recently, the Givrigne, a three-masted vessel with auxiliary engine, that arrived at Paris from Canada with a cargo of salmon preserved in its cold storage hold.

A new ship has just cast anchor at the Louvre wharf—the steamer Louvre, built by Mr. Oriolle, of Nantes. When loaded it sinks but 2·8 meters in the water, and is consequently capable of ascending the Seine with a full cargo. This quality is not the only one that makes a truly original ship of the Louvre; it is the first ocean vessel provided with two central propellers. As long ago as 1889, Mr. Oriolle built the Wilhelmine, a vessel actuated by an internal propeller. Since then he has delivered over a small river yacht with internal propeller, and has converted a side wheel steamer, the Abeille No. 8, into a steamer with central propeller; but all these vessels were for river service only. The results that they gave were so satisfactory that Mr. Oriolle conceived the idea of applying his new system to an ocean vessel designed for coasting trade, and so the Louvre was constructed. This vessel is 53 meters in length and 8·5 in breadth. It gauges 500 tons. It is straight-stemmed, and is provided with two masts and one funnel, all three capable of being inclined in order to pass under the numerous bridges which cross the Seine between Paris and Rouen. As seen externally, it exhibits no notable peculiarity. The two engines are triple expansion. The respective diameters of their cylinders are 34, 62, and 90 centimeters, and each of them is capable of developing 350 horse power. The boilers, which are 2·6 meters in height by 1·8 meter in length, are multitubular generators, composed essentially of two inclined steel plates connected by a number of parallel tubes.

The arrangement of the propellers constituting the true originality of this vessel, we shall describe at greater length. These two propellers are placed a little forward of the center of the vessel, that is to say, forward of the boilers and engines. Each revolves in a sort of tunnel having the form of an inverted U (∩). These tunnels are 1·8 meter in height in the center, that is to say, at the place where the propeller is situated, and they are united by an inclined plane running lengthwise of the vessel. These propellers, which are 1·8 meter in diameter, and of 2 meters pitch, in revolving suck the water in front and force it aft.

As the tunnels are not closed at their lower part, the cavities that they form on each side of the center of the vessel increase the stability of it. The central propellers therefore have the advantage of putting the vessel in a state to remain at sea, which would behave very badly there (seeing the feeble draught that it possesses) were its propeller placed, as is usually the case, at the stern. The Louvre made its first trip in February. It took ten days to go from Nantes to Paris, in touching at Brest, Cherbourg and Havre. Its steadiness was perfect, at sea as well as upon the Seine, and the Parisian Steam Navigation Company, which had it constructed, has been using it since the 15th of February for the regular service between Paris and Nantes, in touching at Brest.

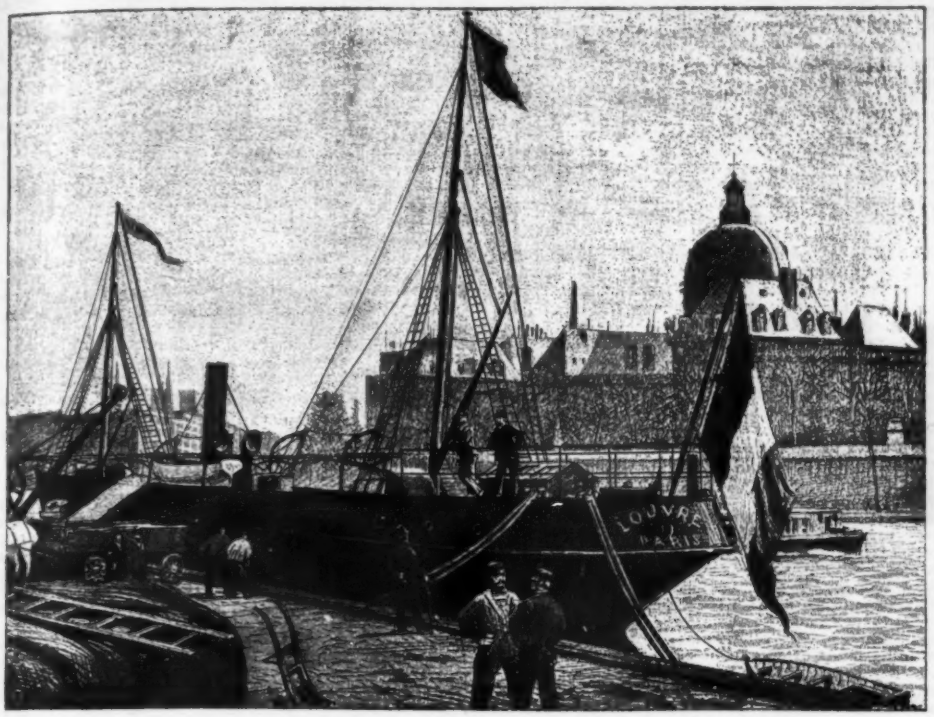


FIG. 1.—THE CENTRAL SCREW STEAMER LE LOUVRE.

Including the Louvre, the maritime flotilla of Paris now comprises five ships, viz., the Emily and the Mabel, belonging to Burnett & Sons and running from Paris to London, with a stop at Rouen; the Parisian and the Borey, belonging to the Parisian Steam Navigation Company, and running from Paris to Bayonne, with a stop at Havre and Rouen; and, finally, the Louvre.

It is only within a comparatively few years that ships have reached Paris. It is about thirty years ago that two steamers from London, the Jacques Paul and the Sophie, each gauging 150 tons, and which are now doing service between Nantes and Bordeaux, landed at the wharves of Paris for the first time. Then appeared at very irregular intervals the Echo, the Esther, the Arion, the Chloe and the Emily. Finally, eight years ago, a regular service was instituted, the Emily making two trips, going and coming, between Paris and London every month; and, since the exposition of 1889, there has been adjoined to the Emily, which is a small vessel gauging but 140 tons, the Mabel, whose tonnage is 320. It takes from four to five days to make the trip between Paris and London. These two vessels do a large traffic, since in 1891 they took on board or landed at Paris more than 11,000 tons.

They carry sugar, preserves and various commodities from Paris to London, and as they cannot descend the Seine with a full load, they complete their cargo at Rouen. At London, they take aboard for Paris leather, paper, metals, chemical products and ox horns, all commodities of which they leave a part at Rouen.

The vessels of the Parisian Steam Navigation Company are of larger tonnage than the preceding. The Parisian and the Borey gauge 650 tons, and the Louvre 500, as we have above stated. The first two run, *via* Rouen and Havre, from Paris to Bayonne, where they deliver their cargo to the Spanish ships that coast along Spain and Portugal. As the outgoing and return trips consume from 28 to 30 days, each vessel makes one voyage per month. The installation of this service is of still more recent creation than that of the service from Paris to London, and as they cannot obtain a draught of water greater than 2·8 meters in the Seine, they are unable to carry a load of more than 450 tons between Paris and Havre; or, if there is reason for it, they complete their cargo at the last named place. On their return, they bring to Paris wines, resins, iron from the Adour forges, etc. During the year 1891 they took aboard or discharged 26,000 tons at Paris.

Last year, the maritime flotilla of Paris carried away or brought in 37,000 tons. This figure is very low if we compare it with that of the general tonnage upon the Seine, which was 4,514,035 in 1889 and 4,734,650 in 1890.

The rapid study that we have just made of the trade done by Paris with foreign countries by means of vessels that do not ascend the Seine, and that are capable of making sea voyages, ought naturally to be completed by an enumeration of the number of loaded boats, trains or rafts which, more modest, run only from Paris to Rouen or Havre.

During the year 1891, 265 boats brought from Havre to Paris 78,144 tons of merchandise, consisting of fuel, fertilizers, wood (2,469 tons), industrial products (3,052 tons), agricultural products (63,320 tons), etc.; in 1890, Havre sent to Paris but 208 boats and 56,623 tons.

Last year, 1,160 boats or rafts brought from Rouen to Paris 428,333 tons of merchandise, sensibly the same as the amount taken to Havre; in 1890, Rouen sent to Paris only 1,326 boats and 325,318 tons. In 1891, Paris sent to Havre 80 boats or rafts, loaded with 11,605 tons (against 78 boats and 13,105 tons in 1890), and to Rouen 1,463 boats loaded with 77,464 tons (against 2,216 boats and 81,746 tons in 1890).

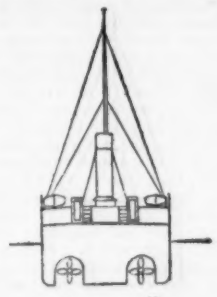
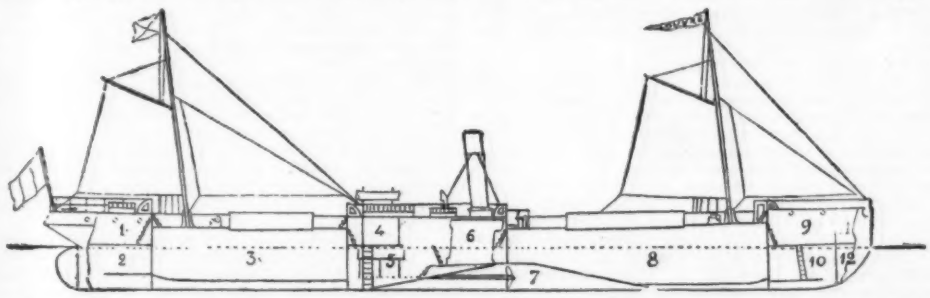


FIG. 3.—VERTICAL SECTION AMIDSHIPS.
A, A', central propellers.

It is precisely the importance of this transit, effected by simple barges, between Rouen or Havre and Paris, that permits the adversaries of the project of making Paris a seaport to assert that there is no need of causing ships to ascend the Seine.—*Le Magasin Pittoresque.*

THE TWIN SCREW STEAMSHIP TUBULAR.

CONSIDERING the amount of attention which the propulsion of vessels by means of screw propellers has attracted for some time past, it will perhaps be of interest to our readers to learn that Messrs. Cochrane & Cooper, of Beverley, near Hull, have recently constructed a vessel, illustrated herewith in section in Figs. 1 and 2, which, it is claimed, is likely to revolutionize the means of propelling vessels so far as river and canal traffic are concerned. The object of this method of construction is to enable steamers to be propelled at a fair speed on rivers and canals without causing back wash, which is so injurious to the banks and to small craft. It is stated that a premium has recently been offered in America for a steamer which would fulfill the above mentioned conditions, and that the Tubular has been constructed, after extensive experiments, with a view to securing this premium.



1. Stern cabins. 2. Provision room. 3. Aft merchandise hold. 4. Engineer's room. 5. Engine. 6. Boiler. 7. Propeller tunnel. 8. Forward merchandise hold. 9. Crew's quarters. 10. Wine hold. 11. Store room. 12. Galley.

FIG. 2.—LONGITUDINAL SECTION OF LE LOUVRE.

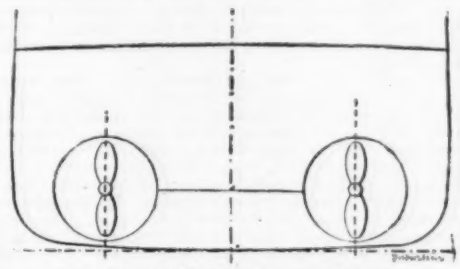


FIG. 2.—TRANSVERSE SECTION.

The dimensions of the Tubular are: length, 94 ft.; beam, 18 ft. 6 in.; and depth of hold, 8 ft. She is fitted with compound surface-condensing engines, having cylinders 9 in. and 18 in. diameter with 18 in. stroke, capable of developing 125 i. h. p., and estimated to drive the vessel at a speed of 10 knots. As will be seen from the illustrations the vessel is constructed with two tubes 4 ft. 6 in. diameter, running longitudinally with and placed about the middle of the hull. Inside and at about midway in the length of these tubes the screw propellers are placed, and are connected with the engines in the usual manner. This vessel has been constructed for the Tubular Twin

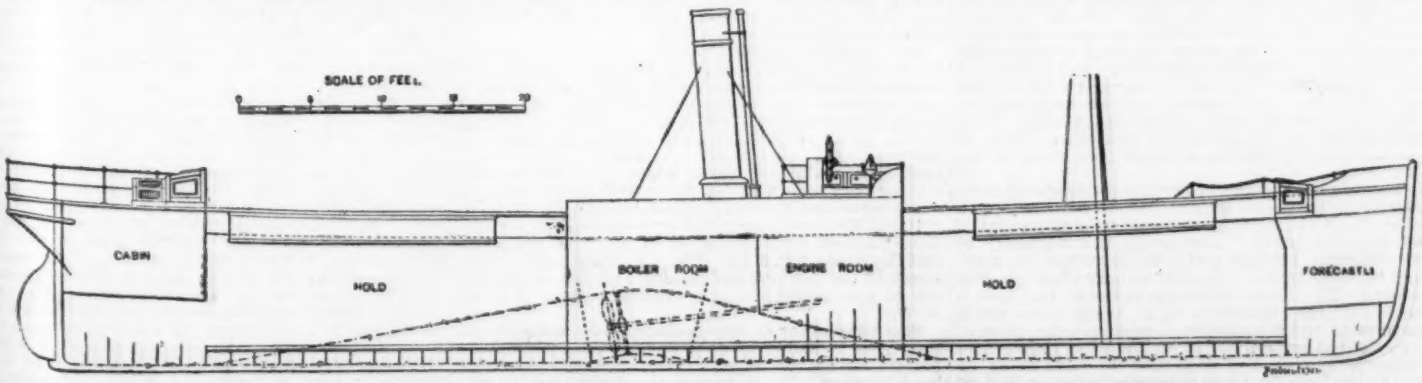


FIG. 1.—THE TWIN SCREW STEAMSHIP TUBULAR—SECTIONAL ELEVATION OF VESSEL.

Screw Amidships Propulsion Company, Limited, of York, and is intended for trading between Hull and York. She has a dead weight capacity of 180 tons.—*Industries.*

H.M.S. VULCAN.

THIS ship, the cut of which has been prepared from a photograph by Mr. Symonds, of Portsmouth, represents an unique specimen of the ship constructor's art in the Royal Navy. She is known as a twin-screw torpedo depot ship, and for this purpose has been supplied with many fittings altogether unusual in her Majesty's ships. She is intended to accompany a fleet to sea, to form a depot for supplying mining and countermining stores, electrical gear, Whitehead torpedoes, etc., to assist in the work of laying out mines or fishing them up, as occasion may require, as well as forming a school of instruction for this kind of work in times of peace. She is also fitted with a factory for executing repairs to torpedo gear and boats, and to such ships of war as are not provided with the means of performing their own repairs. In addition to this, she was designed on such lines that, with the large engine power provided, she would have sufficient speed to act as a cruiser or to perform scouting work for the fleet.

She was built in Portsmouth Dockyard, her first keel plate having been laid down on June 18, 1888, and the vessel launched on June 13, 1889, less than a year after her commencement, a feat which was considered remarkable at that time, but has since become an affair of very ordinary occurrence. She is built of steel throughout, unarmored at the sides, but provided with a steel protective deck varying in thickness from 5 in. in the most exposed parts to 2½ in. below the water line, the shape being the ordinary turtle-back pattern usual in cruisers of this type. This deck forms the protection for the magazines, engines, and boilers, and the vital parts of the ship generally, the coal boxes also being arranged so as to materially assist in protecting these parts when they are full of coal, though naturally such a protection must necessarily be untrustworthy in a ship fitted with such powerful machinery and intended to keep the sea.

The principal dimensions are 350 ft. between perpendiculars and 58 ft. beam, the displacement being 6,630 tons at 23 ft. mean draught. Her bunkers, twenty-one in number, stow 1,000 tons of coal, but 300 tons more can be stowed, if necessary, in the wing compartments adjoining the coal boxes, these compartments having been so fitted that coal can easily be stowed in them or got out to the fires when required. It was considered by her designers that this amount of coal would have sufficed to give the ship a cruising range of 10,000 miles at a speed of 10 knots, but sufficient allowance has not been made for the auxiliary machinery, lighting the ship, etc., and we, therefore, consider that a range of 7,000 miles is as much as she is ever likely to be able to traverse at 10 knots speed without replenishing the bunkers.

A highly interesting feature of the ship is the hydraulic boat-hoisting machinery supplied by Sir W. G. Armstrong & Co., of Elswick. The most striking portion of this machinery, and that which has drawn forth a considerable amount of criticism, both from seamen and constructors, is a pair of enormous goose-neck cranes placed one on each side of the ship, almost amidships. They have a total height of 65 ft., and an overhang, or rake, of 38 ft., which will allow of her boats being hoisted in and out without disarranging the torpedo net defense, a most important item in a ship of this class, the nature of the work she is designed generally to perform rendering her specially liable to sudden torpedo attack.

To provide support and security for these cranes about 30 ft. of the pillar lies buried in the hold, passing down through the upper, main, and protective decks to the bottom of the ship, which is specially strengthened and fitted to support the weight and allow rotation. The upper deck, which takes the canting strain, is also specially strengthened and fitted with a heavy steel ring in which the crane rotates. Rollers are not provided to reduce the friction at this point, the crane being simply fitted with a plain disk about 5¼ in. in thickness, fitting easily in the deck socket. The lifting machinery, which is placed inside the pillar of the crane, and therefore being well down in the hold is fairly protected from gun fire, consists mainly of two hydraulic rams; the larger one 17½ in. in diameter, the smaller one 5¼ in. in diameter, having a vertical stroke of 10 ft., giving a lift of 40 ft. at the purchase, through the multiplying power of the fourfold pulleys, which the rams are constructed to operate in the usual manner.

At the ordinary working pressure of 1,000 lb. on the square inch, the thrust on the crosshead carrying the pulleys is about 118 tons, which gives a lifting power at the gib of 20 tons, moving at the rate of 90 ft. per minute. The small cylinder plays an important part in this mechanism, being designed to mitigate the danger which always attends the hoisting in or lowering of boats in a seaway, and is the subject of a patent by the firm. Its special duty is to keep taut the slings after they have been hooked on to the boat, until a favorable moment for hoisting presents itself. The valves are so arranged that the main lifting power cannot be applied until the small cylinder has been brought into action, the relation of power to weight being so adjusted at the proper working pressure that the slings are only held taut while the boat is rising or falling in the waves, provision being made for the escape of the water from beneath the ram as the weight of the boat forces it back against the pressure. The cranes are revolved by means of a pair of rams 16 in. in diameter, placed vertically alongside the pillar of the crane.

It has been necessary to provide considerably more power for this purpose than would be necessary for a similar crane on shore, since it will be obvious that if boats are to be hoisted in a seaway, it is necessary to have sufficient holding power to overcome the additional twisting strains brought to bear when the ship is rolling. The direct thrusting power of the rams is 90 tons, and they operate a 2½ in. chain cable which passes round and is secured to a steel sprocket drum at the foot of the crane 6 ft. 6 in. in diameter, thence over a pulley at the head of each ram, the ends being secured to the framing which supports the ram cylinders. The cranes have a turning range of about 250°, and the boats are so placed as to come fairly within the scope of one or other of them; but since the Vulcan is 58 ft. wide and the cranes 40 ft. apart, it is obvious that all the boats cannot come within the scope of either crane. To provide for the contingency of one of the cranes becoming disabled, the torpedo boats—of which the ship carries six—are stowed in crutches fitted on trolleys which may be traversed from one side of the ship to the other. It is anticipated that when the ship is in commission and the crew properly drilled, the whole of these boats may be lifted in or out in less than a quarter of an hour.

An ordinary derrick attached to the mainmast for boat-hoisting purposes is also fitted with similar hydraulic gear for topping the derrick and lifting the boats, the lifting power in this case being 10 tons only. In addition to the cranes and derricks, there are also four hydraulic bollards, or winches, provided for general hauling purposes, and for use with the derricks. They are guaranteed to be equal to a direct pull of 30 cwt.

The boat equipment consists of six second-class torpedo boats, a wood vedette boat 53 ft. in length, a 42 ft. steam pinnace, and a steam cutter. The torpedo boats are built entirely of steel, 60 ft. in length, having a speed of over 16 knots per hour, the engines working up to about 430 horse power, the boilers being of the ordinary locomotive type, working under forced draught with closed stokeholds. The vedette boat and steam pinnace are also fitted to work with closed stokeholds and forced draught. In addition to these boats, the ship also carries two specially designed countermining launches, besides the ordinary equipment of sailing and pulling boats.

For offensive purposes the ship carries an armament consisting of eight 4·7 in. rapid-firing guns, mounted upon the Vavasseur central pivot system, four forward and four aft on the upper deck. These are fitted with the usual protective shields, and have a good arc of training, the bow and stern guns both firing across the keel. In addition to these there are twelve 3-pounder quick-firing guns distributed between the main and upper decks. In addition to these guns the ship will be provided with an equipment of thirty Whitehead torpedoes, some of which will be of the latest pattern, 18 in. in diameter, carrying a charge of 242½ lb. of dry gun cotton, and having a total weight—including the head—of upward of 1,150 lb., the remainder consisting of the ordinary pattern torpedo, 14 in. in diameter, and carrying various charges up to 115 lb. of gun cotton. For discharging these torpedoes, two fixed tubes are provided below the water-line forward, one for 18 in. and one for 14 in. torpedoes; a fixed tube at both bow and stern for 14 in. torpedoes, above the water-line, and two broadside training tubes for 14 in. torpedoes above the water-line aft.

In addition to the locomotive torpedoes, the ship also carries a large number of mines, which may be laid down as desired. Some of these carry as much as 500 lb. of gun cotton, the total weight of each mine when complete reaching upward to 1,300 lb. Last, but not least of the offensive weapons of the ship, is the powerful ram with which she is provided.

The ship is lighted throughout by electricity, and fitted with four electric search lights, each of 25,000 candle power. For these purposes three sets of Siemens dynamos, driven direct by Willans patent compound central valve engines, are provided, each dynamo giving a current of 400 amperes at 80 volts E. M. F. when driven at about 420 revolutions per minute.

Being unarmored, great speed is relied upon as the principal defense, but she is also provided with a perfect torpedo net defense, besides the protective deck mentioned above, while in addition the principle of subdivision has been thoroughly carried out in her construction, in order to minimize as much as possible the chances of her being sunk in action by a lucky hit from either torpedo or shot, the number of these water-tight compartments reaching upward of 140. The carrying out of this principle of minute subdivision into water-tight and air-tight compartments brings into greater prominence the matter of ventilation, a proper supply of fresh air to these compartments being of course necessary to enable the work of the ship to be carried on without detriment to the health and comfort of the crew. To insure this numerous air shafts are led down from the upper deck, some for supply and others for exhaust, air trunks being led from these to every compartment in the ship, including bunkers, magazines, store rooms, etc., ventilating fan engines driven by steam being connected to some of the most important trunks to supplement the natural draught when necessary.

To preserve the principle of water-tightness it becomes necessary to fit each of these air openings with a valve capable of being shut down when necessary, and when it is remembered that many compartments have a valve for supply and another for exhaust, some idea may be formed of the enormous number of valves necessary for this purpose alone: when to these are added the water-tight doors and hatches, the sluice and drain valves, and suction valves to the various pumps, mostly fitted with shafting and gearing to admit of their being worked from the main deck, it will be seen that the task of keeping all in good working condition forms no small portion of the duties of the engineering staff of the ship.

The propelling machinery and boilers were supplied by Messrs. Humphrys & Tennant, who, indeed, were responsible for the supply and fitting of all the auxiliary machinery in the ship, with the exception of the hydraulic machinery. They also supplied the fittings for the factory except the machines, but all machines, shafting, etc., were fitted in place by their workmen. The main engines, of which there are two sets driving twin screws, are of their well known type of triple expansion overhead cylinders, capable of developing 12,000 horse power at 100 revolutions per minute. The cylinders are of 40 in., 59 in. and 88 in. diameter, and the stroke 4 ft. 3 in. The air pumps are driven direct off the low pressure pistons, and the condensers are of gun metal, giving a cooling surface of 13,500 sq. ft.

The circulation of the cooling water through the condenser is maintained by independent centrifugal pumps, driven by Humphrys' single cylinder overhead engines. These pumps are duplicated, to provide for the contingency of one becoming disabled, the old plan of fitting sea injection cocks in case of emergency having been discontinued. These pumps are also fitted to draw from the bilge, and guaranteed to take 100 tons per hour each from the bilge with 100 lb. pressure of steam. This they easily did at the trial, the total amount of water delivered by the four engines, as ascertained by experiment, being a little over 5,000 tons per hour.

There are no feed pumps driven off the main engines, but separate feed engines, two main and two auxiliary, all of equal size and Admiralty pattern, are fitted in the stokeholds for supplying the main boilers, a smaller pattern being supplied for the auxiliary boiler. In each engine room there are also two fire and bilge engines, one turning and one reversing engine, a distilling pump, an auxiliary condenser, which takes the exhaust steam from the whole of the auxiliary service, having its own circulating engine and air pump, and a Normandy's double distilling apparatus capable of providing 150 gallons of fresh water per hour for the use of the crew.

Separate engine rooms are provided for the hydraulic engines, of which there are two complete sets, each set equal to the task of supplying the pressure for the cranes and bollards, etc., when hoisting in the boats. They are horizontal tandem compound type, two high pressure cylinders of 13½ in. diameter, and two low pressure cylinders 27 in. diameter, with a stroke of 18 in., to each set, pumps, 5¾ in. diameter, being driven direct off the pistons in the ordinary way. No hydraulic accumulator is provided, but a hydraulic governor efficiently supplies its place by controling the supply of steam to the engines as the water pressure varies.

Murdock's steam governor is also connected to the throttle valve in case of mishap to the pump, to prevent the engines running off at a breakdown speed. In each hydraulic engine room there are also one of Belliss' air compressing engines and pumps, with reservoir for supplying Whitehead torpedoes with air up to a pressure of 1,700 lb. per sq. in., ventilating and exhaust fans driven by Brotherhood's three cylinder engines; and, on the starboard side only, one of the dynamos—termed the war dynamo, because it is placed under the protective deck, the other two being placed in the workshop above the protective deck, where it is presumed they can be much better attended to, being under the direct supervision of the officer in attendance there.

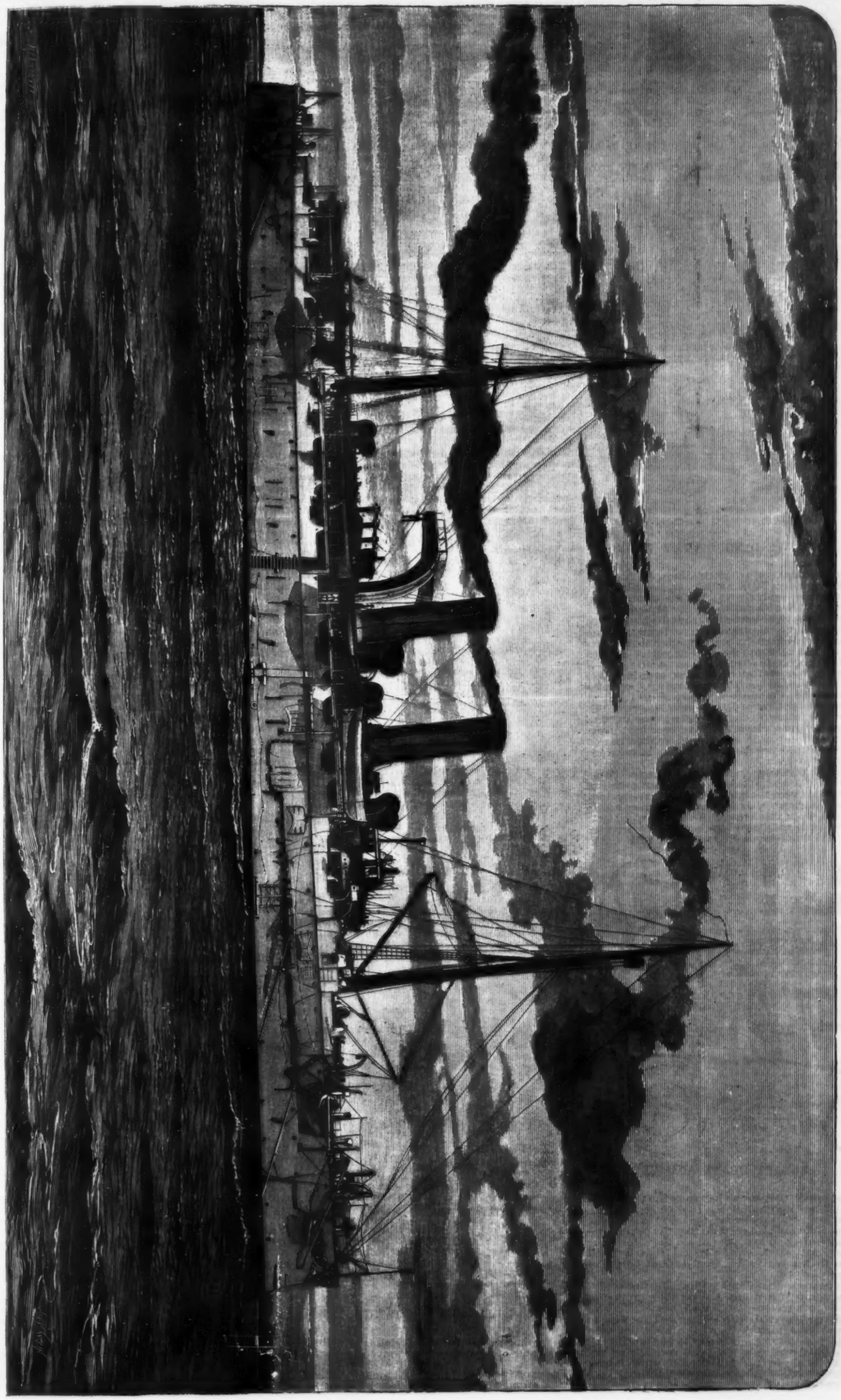
In the workshop there are five lathes of various sizes, from 15 ft. bed and 9 in. centers down to 3 ft. 6 in. beds and 6 in. centers, two drilling machines, planing, slotting, shaping, and punching machines, a circular saw bench, a carpenters' bench and fitters' benches, and a Fletcher's air furnace capable of melting down 2 cwt. of scrap steel in two hours. The pulley shafting is driven direct by a 6 in. belt off a small single cylinder horizontal engine of Messrs. Humphrys' design and construction. In the blacksmiths' shop on the upper deck is a powerful hydraulic forging press, a large forge fitted with Roots blower and steam blast, also a coppersmiths' forge and pipe bending machine, together with a complete set of tools.

To supply steam there are double-ended cylindrical boilers, 17 ft. long and 14 ft. in diameter, with three furnaces each end, 3 ft. 8½ in. diameter, 6 ft. in length, leading to a common combustion chamber. There is also, in addition, a smaller boiler, single ended, 12 ft. 5 in. in diameter and 9 ft. 4 in. in length, with three furnaces, which is intended to be used generally for auxiliary purposes, but which is worked under the same conditions of forced draught as the main boilers. The stokeholds are closed, and fitted in the usual way with air locks for entrance, air tight hatches, etc. The air for the fires is driven into the stokeholds by eight 60 in. fans, driven by Brotherhood's three cylinder engines working up to 600 revolutions per minute. As originally designed, the total grate area was about 655 sq. ft., and the total heating surface about 19,000 sq. ft.

Certain modifications, however, were suggested by experience with similar boilers in other ships in order to prevent over-heating of the tube plates, and consequently leaky tubes. These when carried out reduced the grate area to about 543 sq. ft., and the heating surface to 16,740 sq. ft. In spite of these alterations, however, some trouble has been experienced with leaky tubes when the boilers are cooling down after forced draught has been applied; and it was at one time thought that new boilers would be necessary. More recent experience with some ingenious devices of Messrs. Humphrys' and the Admiralty engineers has, however, led to the expectation that all these troubles may eventually be overcome, and the commissioning of the ship has therefore been delayed until the alterations suggested by the success which attended the recent trials of H.M.S. Thunderer at sea have been carried out. It is understood that the boiler tubes are to be fitted at the combustion chamber ends with the Admiralty ferrule, and the heating surface and grate surface restored to the amounts approximately as designed. It has also been decided to fit additional evaporators in order to maintain the supply of fresh water for the use of her own and the torpedo boats' boilers. Grease extractors are also to be fitted to prevent the admission of oil into the boilers. We cordially wish success to the Engineer-in-Chief of the Navy in his laudable attempt to save the taxpayers' pockets. The weight of the machinery is 1,030 tons, or 11·6 indicated horse power per ton.

Curiously enough, in the first trial trips, which were carried out to determine the acceptance of the machinery by the Admiralty from the contractors, no trouble was experienced with the tubes, a mean speed of 18·5 knots having been maintained for eight hours with a horse power of 8,167, the revolutions of the engines being 88·6 starboard and 88 port, with a mean air pressure in the stokeholds of 0·457 in. of water. It has not yet been considered advisable to attempt the 12,000 horse power; but it is to be hoped that this magnificent vessel may not have to be kept waiting ignominiously in harbor much longer on account of boiler-tube troubles, but that with more modern devices she may be enabled to attain to her full speed of 20 knots for a few hours, and to keep her sea-going speed of 18 knots as long as her coal may last. We are indebted to the *Engineer*, London, for the foregoing particulars and for our engraving.

THE BRITISH TORPEDO DEPOT SHIP VULCAN.



SINGLE WIRE, NON-INSULATED TELEPHONY.

THE characteristic of the effort made by electricians in recent times to favor the extension of telephonic applications is a return to simple apparatus of compact construction. Some have tried to modify the receivers, and in this order of ideas we may recall the fact that the Aubry apparatus gives good results, as is also the case with the Roulez receiver constructed at the artillery shops.

As regards transmitters, the multiplicity of the microphones produced in recent years has, so to speak, overwhelmed the researches of electricians and prevented them from pursuing a practical and definite object, and they have been content for some time to seek perfection of regulation and strength in the apparatus.

Aside from these two important points, the great preoccupation has been the installation of aerial, sub-

FIG. 1.—UNWINDING OF THE WIRE.

terranean, or submarine telephone lines, the improvement of the processes of manufacturing the cables, the increase of their conductivity, the augmentation of the properties of the insulants, and the explanation of certain phenomena of induction, the effects of which very justly inquieted electricians in particular, and all persons in general, who, in utilizing the telephone as a mode of communication, found themselves doomed to suffer from this state of things.

Along with these multiple questions, certain labors have been performed that, by themselves, present a certain interest. Certain conditions of establishing lines have been determined that promise great surprises for the future, and great enterprises, such as that of long-distance telephony, have been brought to a successful end. In this category of studies the establishment of the Paris-London line may be regarded as an event.

But, along with the engineers who interested themselves in this idea and who solved important problems in so happy a manner, there worked other investigators, who, proceeding in an entirely different manner, reached results of just as vast a range. After the experiments on telephony without wires of the lamented Bourbouze, following the experiments on telegraphy with naked

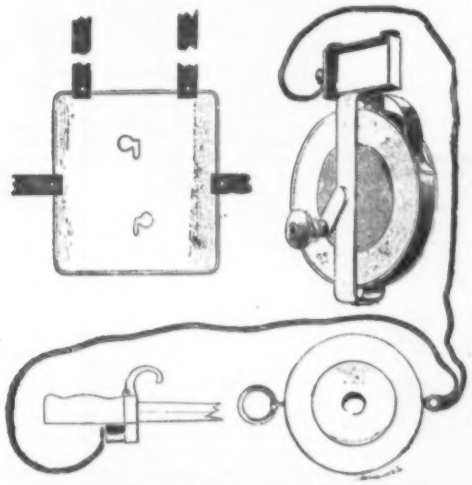


FIG. 2.—BREAST PLATE AND REEL.

wire of Captain P. Cardew, we have now the telephonic processes of Captain Charollois. It is these latter experimentations, still very recent, that we shall submit to deep examination, being certain that the popularization of the results acquired can but aid the more in the development and extension of a system that by itself is destined to a great future, from several points of view, as we shall see.

The arrangement that Captain Charollois was studying as long ago as 1888 utilizes the peculiar properties of a special conductor—the Martin bi-metallic wire with steel core covered with copper. This wire is stronger and less oxidizable than the wires in daily use in electrical applications. It is now to be found in the market, and its relatively low price specially recommends it for hundreds of installations in which it may advantageously replace the ordinary conductor.

The characteristic of the Charollois arrangement resides essentially in the use of this wire, which, unwound naked upon wet or dry earth, or even upon grass covered with dew, or in water (in which it may be submerged for a certain length), constitutes a telephone line which, ending at its two extremities in two

FIG. 3.—METHOD OF CARRYING THE REEL DURING A MARCH.

magnetic receivers, transmits, by earth return, the induced currents circulating between these two receivers, and, at distances that are sometimes considerable, permits of exchange of conversation and acoustic signals under conditions that are eminently practical and curious: practical in the sense that these lines do not necessitate a special set of instruments, and that the

FIG. 4.—WRITING A DISPATCH.

installation, effected in a summary manner, is exceedingly simple; and curious in that the theories generally admitted on the subject of the propagation of currents by naked wires seem to be demolished.

In this category of experiments there are several phenomena that might give rise to a theory which, if not new, is at least singular and upon which we shall not dwell, confining ourselves simply to a mention of

FIG. 5.—TELEPHONIC COMMUNICATION.

the experimental conditions of trials that we have witnessed and of results that we have directly appreciated.

The experiments of Captain Charollois, with the aid of the arrangement devised by him, and that we have just analyzed, relate to two applications that present more than one point in common. The principal one relates to the adaptation of this process to military operations, and the second to industrial and domestic uses.

Let us proceed, then, in the same order for the description of the experiments. In the application to military operations, the Charollois arrangement, which gave excellent rusults in the grand maneuvers of the North in 1890, and of the East in 1891, includes the organization of a telephone service capable of being understood at a distance of a mile, and putting in communication the elements of an army corps by means of intermediate stations arranged upon the line in any manner whatever. The establishment of the line offers some peculiarities that it is well to bring into prominence. Let us say, in the first place, that the diameter of the wire is only of secondary importance as regards results, and were it not for fear of breakage in a rapid

FIG. 6.—UNWINDING OF THE WIRE BY A CAVALRYMAN.

unwinding, the finest possible bimetallic wire might be preferred.

Upon the whole, the choice is indifferent. Experiment has been made with the same success with wires of 0·15, 0·02, 0·03 and 0·06 of a millimeter without a sensible diminution of the sounds furnished to the receivers.

In view of an organization that may be shortly expected, a complete *materiel* has been devised for realizing the establishment and taking up of a military line in a very short space of time.

Under ordinary circumstances, the arrangement by relays includes but a light *materiel*, the entire equipment being reduced to less than five and a half pounds.

The telephonists are organized in sets. Each set comprises two men. The first (Fig. 1) carries upon his chest a sort of breast-plate held by leather straps. This plate, the details of which are given in Fig. 9, is made of steel and is provided with two apertures for the reception of the pins of the wire bobbin. The latter, which also is represented on a large scale in the figure, is formed of a grooved pulley upon which may be wound 10,000 feet of wire. The pulley is held by its axis between the branches of a U shaped iron which carries at its anterior extremity and upon one of its lateral faces the pins designed to fix the bobbin at right angles or parallel with the breast-plate. Fig. 2 clearly indicates the form and working of the plate and bobbin. Finally, the pulley is connected with a winch that permits of winding up the wire when the line is taken up. Fig. 3 represents the telephonist at rest and equipped.

In the case of communication by cavalrymen, the breast-plate includes a rod terminating in a small pulley held in a fork and movable in all directions, designed to facilitate the unwinding of the wire.

In all cases, the receiving and transmitting apparatus remain fixed to the strap of the "kepi," and permit of listening or talking and of transcribing a dispatch with the greatest facility.

FIG. 7.—TELEPHONIST ON A BICYCLE.

Figs. 4 and 5 show how this double operation is performed. When the telephonist is at a standstill, he can increase the clearness of perception by completing though his saber bayonet stuck in the earth, and connected with the second terminal of the receiver, the return to earth that is effected in principle through his body itself. So too when it is a question of a cavalryman, the return is constantly assured in an efficacious manner by the shoes of the horse (Fig. 6).

The line, consisting of a wire unwound upon the ground, and hooked to trees, bushes, etc., without any insulation, is laid very rapidly by foot soldiers, cavalrymen, or bicyclists (Fig. 7).

Each set, comprising two men, carries the *materiel* necessary for the establishment of a one mile line. It is installed at the extremity of the line and is connected with the line that follows, and, while the second operator remains charged with the surveillance

of the line laid by his set, the other keeps himself in permanent telephonic communication with his original station and the telephonist of the set that goes before him.

Under such conditions it will be seen that the establishment of the line proceeds with great rapidity. The taking of it up is done still more quickly. Fig. 8 represents the telephonist performing this operation. At the last maneuvers, a 14 mile line was established thus in five hours and taken up in one hour.

The passage of a division of cavalry over the wire did not, in the course of an experiment, interrupt the communication of a dispatch that was being sent at

FIG. 8.—WINDING UP OF THE WIRE.

the same moment. The line attached to a captive balloon has been utilized for the exchange of orders without any difficulty.

A great advantage of the telephone system is the centralization of the orders. Thus, on the 14th of September, 1891, an order of assault, setting in motion two army corps, was received and put in execution in ten minutes.

Some recent experiments have once more verified the facts that we present, and, not long since, a line of this nature that had been hastily established from the Reuilly barracks to Joinville-le-Pont operated with complete success. In other experiments we have ascertained for ourselves the merits of this telephonic system upon a line installed in a few minutes on the extensive grounds of the works for raising the water of the Marne, at Saint-Maur-les-Fosses. This line, which had a total circuit of 10,000 feet, permitted of making some conclusive experiments. The line was laid on the ground without any supports.

A system of call styled "dog" used in the army has been tried. This call is produced by means of an instrument devised by Mr. Sieur and in which a wheel carrying a series of strips of steel upon its circumference and passing between the poles of a magnet develops currents of variable frequency, which, circulating in the line, produce in the receivers a characteristic signal perceptible at a distance and imitating the bark of a dog.

Calls for industrial installations have also been devised, and under such circumstances it appears to us that this telephonic system is capable of being used for connecting the interior services of a manufactory, of a mine, or of any kind of enterprise or private installation.—*Annales Industrielles.*

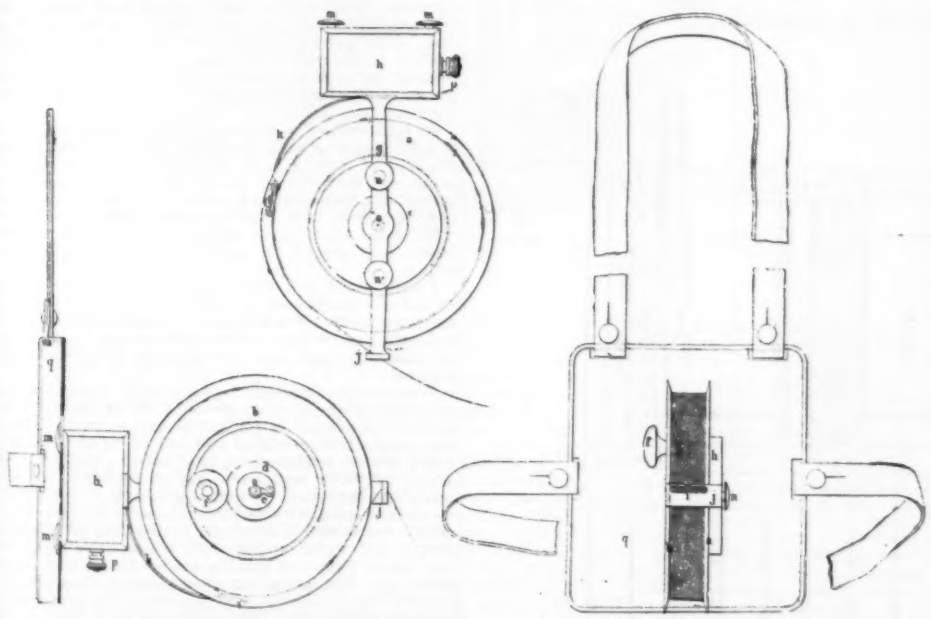


FIG. 9.—BREAST PLATE AND REEL FOR MILITARY TELEPHONY.

THE result of the effort made to preserve piling by a process of creosoting is very satisfactory and shows that the wood is kept in as good a state as when first put in the water.

[GARDEN AND FOREST.]

OIL MAKING IN ITALY.

THE Italian autumn gains a fresh picturesqueness from the active groups about the olive trees engaged in the harvest of this classic fruit, which is still treated with old world conservatism, after the antique methods of the forefathers. On the ground are spread great sheets, upon which the fruit is heaped as it is gathered, and busy groups come and go around the old gray foliaged twisted trees, whose tormented attitudes suggest always that they are at variance with the climate, and are fretting after a warmer region sheltered from Mediterranean winds and the cold breath of the tramontana.

The olive picking is a delicate business, for it is useless to gather the crop before it is ripe enough, and no less disastrous to delay a day too long. So in the heaps of gathered fruit quite a third of the berries are usually green. Like the high bush blackberry of our native land, the fruit turns from green through red to a bluish black. It needs gentle handling and ought always to be picked by hand. Nor is this a difficult matter, for the trees, if properly cultivated, are well cut back to keep them stocky, while the branches are cleared out from the center and trimmed across the top, at about fifteen feet from the ground, as smoothly as any hedgerow in England. Once brought to the desired shape and size, they can be so maintained for centuries. The flavor of the fruit is said to improve with the age of the tree. The olive trees on the slopes below Tivoli are said to have seen the Emperor Hadrian's sumptuous villa in all its splendor.

The men use ladders and take charge of the upper branches; the women, bareheaded or brightly kerchiefed, stand about and pick all the fruit within reach; children swarm about the ground for the fallen berries. They sing a snatch of some Tuscan stornello, which is taken up and carried on from tree to tree and orchard to orchard: but in the midst of the strain they break off to indulge in a bout of the most unsparing chaff, to dispute some mandate of the overseer, or to pay their respects to the padrone or owner of the property as he passes, mounted on his sure-footed little pony. Over all the sun is shining gloriously, in a sky so blue that the gray olive leaves turn white against it, and so still as to seem almost unearthly to one accustomed to the atmospheric unrest of New England.

When their large, flat baskets are full the pickers take them to the granaries to be emptied. The sooner the berry can pass from the tree to the mill the better, says the Tuscan farmer, but though the machines are kept working night and day in the height of the season, they do not suffice if the crop be large, and the superfluous berries are carefully spread in thin layers upon dry floors. There is in the olive a thin watery liquid, the same which makes the fresh fruit at once so nauseating and bitter to the taste, and this, almost as soon as the olive has left the tree, begins to ferment and work its way out of the fruit. It must dry off at once or a mould forms upon the berries, which renders them absolutely worthless.

As soon as may be, therefore, the olives are picked over, cleared of leaves, washed, if necessary, and taken to the press. Since oil making demands, above all things, an equable temperature during all its processes, the uliviera, as it is called hereabout, is usually installed under ground. Accepting an invitation to enter one of these the other day, we found ourselves, when once our eyes were used to the dim light, in a great branching cavern, hollowed out of the soft rock of the Sienese hillside. Above was a roughly groined ceiling, on our right the olive presses proper, before us the machines for crushing the fruit, and beyond a charcoal fire with a huge kettle of boiling water suspended above it. In a dark corner a door led to the inner cave, where the oil is clarified.

There were two crushing machines at work when we entered. The base of each consisted of a huge circular block of the yellow marble of Siena, seven feet in diameter, eighteen inches high upon the outer edge, and sloping inward to a depth of about six inches in the center. Here was inserted a massive iron pivot, with a short arm attached to a mill stone of the same beautiful stone as the base, and which was driven round and round in the cavity by one of those sturdy little ponies which are the pet and pride of every Tuscan farmer. Unwearyingly these two closely clipped, mouse-colored, willing beasts kept at their monotonous task, giving a friendly nip at one another as they met on their circling paths or responding to a caressing word by a hasty rub of the head on the shoulder or arm of the driver, but never lagging for an instant on their unending round.

Into the hollow of the lower stone is first thrown a heap of olives, perhaps two or three pecks, a little boiling water is added and the horse starts off. The water has to be renewed from time to time, and the revolving stone, which has been so set as to detach the pulp as much as may be without breaking the stone of the fruit, not only bruises the berry but slowly forces the whole mass of pulp about the cavity. After some fifty minutes it will have made a complete revolution and it is then ready for the first pressing, which yields the finest oil. After this the pulp goes back to the mill stones for a further crushing, is then repressed for second class oil, and the refuse of this is sold to the proprietor of a steam press, who still succeeds in extracting a profitable amount of machine oil.

Steam in new establishments often replaces horse power at the crushing mill, but the press is always worked by hand. It takes intelligence—and experience too—to tell when the screw has received a sufficient number of turns and when the pressure may again be increased. The crushed olives, called at this stage lansa, are confined under the screw pressure by means of gabbie, which look, as you see them hanging before the shop door, like elaborately twisted coils of clothes line, but which are really bags woven in circular shape, each capable of holding two or three quarts of pulp. A half dozen of these are slipped over the upright of the iron screwpress, which has long replaced the clumsy wooden lever of early Roman days, and pressure is put on most gently and cautiously for the first quality of oil, but with less precaution for the second grade, when the stones have been crushed.

The oil as it runs from the press to the great earthen jar beneath appears of a brownish color, owing to the presence of the bitter watery liquid before mentioned. The specific gravity of this and of the oil proper is, however, so different that the work of clarifying begins at once and spontaneously. It is assisted and consummated in the dim inner dungeon, but the secret of this process is never revealed. The great vases of rude pottery are ranged about the walls, each displaying a more advanced stage in the clarification of its contents, till finally a beautiful smooth, translucent, greenish yellow liquid is revealed. But it is not wholly out of politeness, as we know, that the three workmen suspend their labors when we come in, and though their chief makes the round of the little room with the greatest affability and responds with true Italian courtesy to every question, his elaborate answers are distinctly vague. "Water is used in a proper quantity, at a proper temperature, which he himself determines; the oil is poured back and forth a proper number of times, when that seems the proper thing to do. The signorine must find all these details very dry, and he asks their pardon for troubling them." The signorine know at all events when questions are useless, and with an exchange of compliments take their leave.

When the oil comes out of the magician's black cave it is ready for the market, but it is usually kept on hand for a time in a store room, the floor of which slopes toward a central hole, under which a great earthen jar is set. If no breakage occurs, the only further care the oil receives is to be trans-vased as a precaution against fermentation when the great summer heats begin in June; otherwise it simply stands and waits its market. About thirty-five per cent. duty, ad valorem, is paid on it when it enters the city gates, and the shopkeeper doubtless takes his profit, but even so the finest quality costs the housekeeper twenty-seven or twenty-eight cents a quart, and the finest quality is used, not only for the table and in cooking, where it admirably replaces lard and butter for frying and basting, but even in the tall classic lamps. "Anything but the very best always has an evil odor," the servants say, and they are doubtless right, but it always pains my New England thrift to see the beautiful greenish golden liquid put to so base a use.

LOUISE DODGE.

SOAP MAKING WITH COTTONSEED OIL.

THE following account, given in a communication to the American *Soap Journal*, of how this oil is employed by a practiced soap maker, contains much information upon this point which is of a useful nature. The question of how much soap a given quantity of tallow will make is often a difficult point to gauge. In the following method one of the advantages claimed is that the yield of soap agrees with calculated yield, 180 lb. of fat giving 535 lb. of clear waxy soap. The formula given below has been successfully used for eighteen months.

	Pounds.
Refined cottonseed oil	164
Tallow	16
Resin "K"	75
Silicate of soda "N"	75
Palm oil	1
Caustic lye, 35° B.	153
Starch	3¾
Sal soda	5
Silex	40
Water	1¼
Perfume	1
	535

The method adopted for working up this formula is as follows: Commencing with the cooling frame, the materials are framed, thus avoiding framing the soap. This necessitates the use of a good tight frame in which the cottonseed oil, palm oil, and tallow, carefully weighed or measured, according to the proportions given above, are placed, having first been warmed to a temperature of 115° F. The resin, previously warmed and cut with a small amount of weak lye to keep it fluid, is then added.

The frame is now rolled under the mixing machine, which has movable shafts and blades. These mixer shafts are lowered into the foregoing mixture and set in motion. The caustic lye and the sodium silicate are now added, and the mixture stirred for seven to ten minutes, when the starch and sal soda and silex are

added, and the whole stirred for another four or five minutes. The mixture should then have a glossy and smooth appearance, indicating that the incorporation is complete. The perfume is added, the mixing blades removed, and the frame set aside to cool. The soap will be quite hard in a reasonable length of time. It may be stripped on the second day, and cut upon the third. The difference in cost between tallow and cottonseed oil introduces the element of economy, while there is no loss save the moisture which evaporates during the three days cooling, no spent lye and no nigres. Lastly, the soap is found to do good work in actual use in the wash tub, containing less moisture than there usually is in boiled and settled soaps.

IMPROVED GOLD SAVING MACHINE.

THE illustrations represent various views of Mudie's gold saving, crushing, and amalgamating machine, employed at Elaine, Victoria, Australia. Fig. 1 represents an end elevation, and Figs. 3 and 4 a sectional elevation and plan respectively of the machine, while

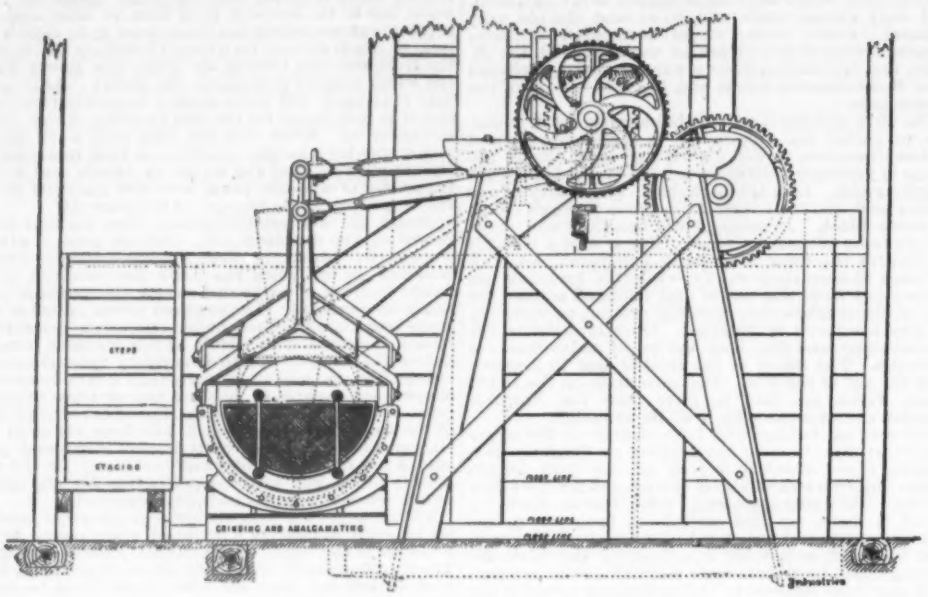


FIG. 1.—END ELEVATION OF MACHINE.

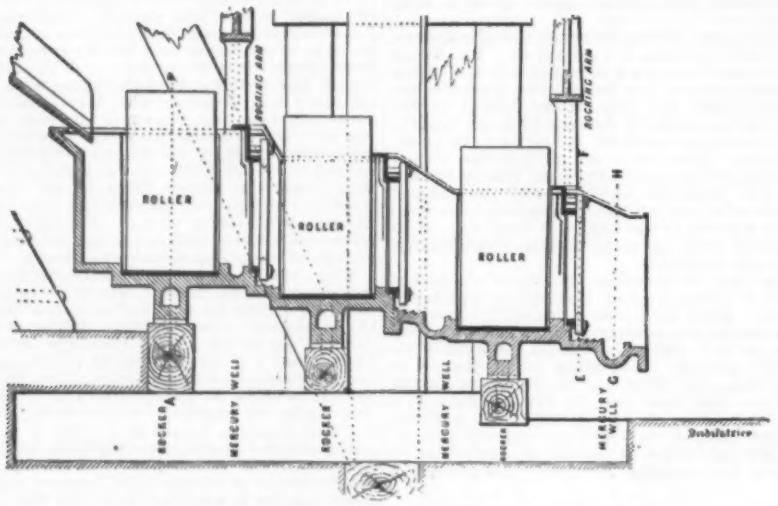


FIG. 3.—LONGITUDINAL SECTION OF MACHINE.

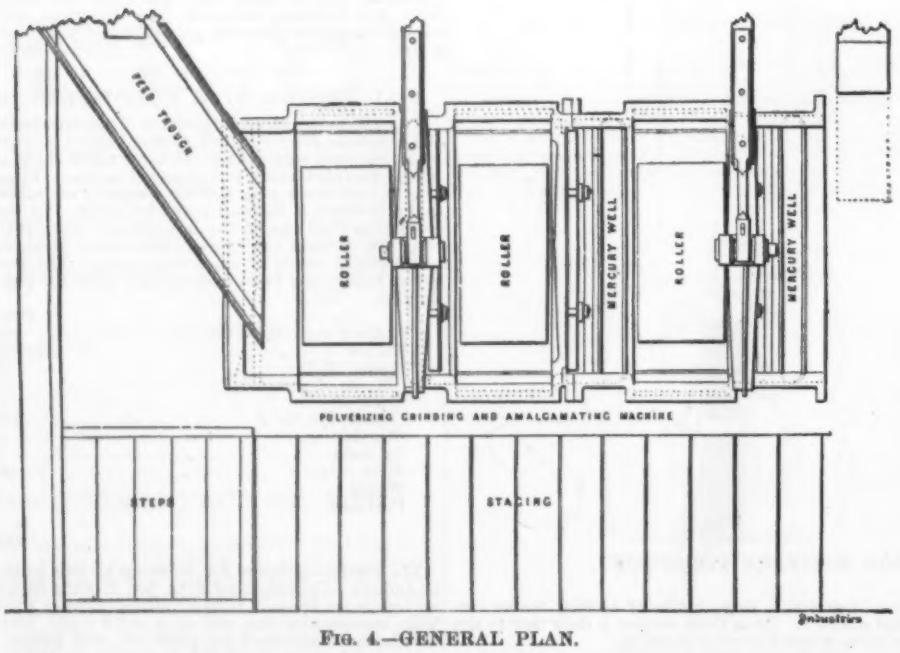


FIG. 4.—GENERAL PLAN.

IMPROVED GOLD SAVING MACHINE.

Fig. 2 represents three sections of the trough. The machine consists essentially of a cast iron trough 3 ft. wide, lined with boiler plate, in which the rollers work. It is divided by partitions into three divisions; in each of these a roller 2 ft. diameter and 12 in. wide works. There is a fall from each division to the next one, as shown. The method of working is as follows: The quartz is first broken small and then fed into the first division; in this part there is a quicksilver well, into which the quartz drops, and from there passes under the first roller, where it is crushed to a size that will allow it to pass through the grating fixed in the division into the second compartment, where it is crushed finer, and then passes through a punched grating with 900

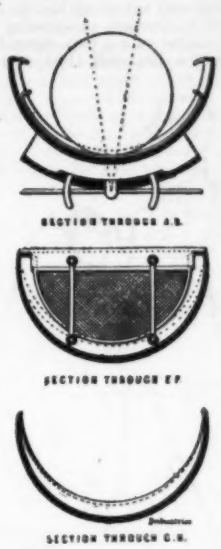


FIG. 2.—SECTIONS OF TROUGH.

holes per square inch, also fixed in a division; it then flows into a silver well lined with amalgamated copper plate. From there it passes under the third roller, and is still further ground, and then passes over another silver well also lined with amalgamated plates, and from this it flows over a short table and is discharged.

The machine can be driven by a horse at a speed of 54 oscillations per minute; the length of each oscillation being 8 in. The machine shown, when working continuously, is capable of crushing 18 tons of quartz per week. It requires, we are informed, very little fixing, and can be erected without skilled labor, and should, therefore, be found serviceable in outlying districts. According to an official report, the machine might be improved by putting rings of hematite iron on the rollers (wedged on with wood); these could easily be renewed instead of having to provide new rollers, and there would be no wear on the rollers. It would also improve the gold saving properties of the machine if the crushed material, after it left the machine, had to pass over quicksilver and blanket tables in order to trap any fine gold that might pass the ripples.

SETTLED LAUNDRY SOAP.

By F. EICHBAUM.

CURD soaps not only take first rank among bar soaps, but of late years they have attained the largest consumption. The laundry curd soap is much used in Germany, and, where clean grease and caustic soda are available, it is generally made by the direct process. The greases which find use in its preparation, besides cocoa nut and palm kernel oils, are cotton, peanut, palm and bleached linseed oils, elaidin, bone grease, animal grease and lard mixed together in varying proportions.

As late writers on the subject have proposed the use of such grease as each thought would yield the greatest amount of soap, I have recently been working to the same end with the so-called "kammfett," the animal grease mentioned above, which is composed of a mixture of tallow, lard, and the grease from horse fat, and with firm white olein (obtained by distillation from waste mill grease) in combination with palm kernel oil.

I have tried this white, firm olein by direct boiling in various combinations and have obtained very satisfactory results. For instance, I proceeded with a batch consisting of 1,584 pounds of palm kernel oil, 220 pounds of animal grease, and 1,276 pounds of white olein as follows:

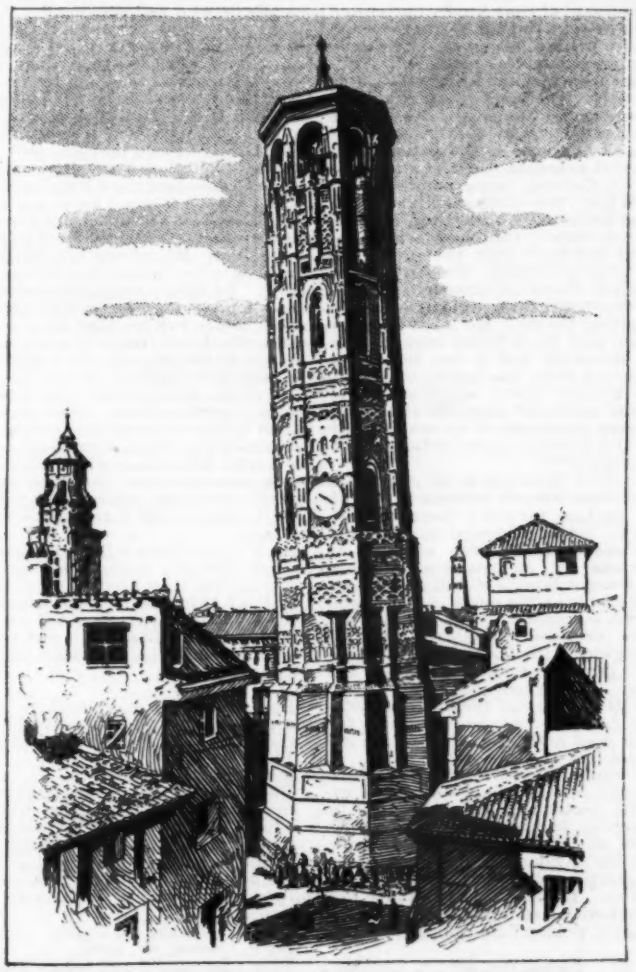
The scraps at hand, together with about the same quantity of caustic soda lye of 26° B. as there will be of grease, are placed in the kettle and melted. The animal grease is then added and boiled in, and the liquid palm kernel crutched in, in divided portions. After about fifty-two pounds of salt are added to the soapy mass, the firm olein is added gradually. About eight pounds of soda crystals should now be thrown into the pasty mass and the whole boiled free of foam and strong salt water added with constant stirring until the paste feels wet and the grains flatten out on bubbling up. The operation of separation should be conducted very carefully, as otherwise the soap will be entirely salted out. If it should happen that the soap has been too much salted, and the lye drops from the paddle when taken out, the soap should again be drawn together by adding hot water until a smooth paste is obtained that is readily moistened.

The kettle should now be covered for a few hours and then, when the handsome, honey yellow soap is removed, that results from carrying out the process correctly, there will be found a thin layer of dark paste containing the impurities present, below which is the spent lye. By this method but little of this dark paste is formed, but about 145 per cent. of pure white soap is obtained.

When cooled in the forms, this soap exhibits a silvery luster, and is quite firm. After long drying it generally assumes a light yellowish color, and becomes somewhat transparent, which is rather an advantage. —*Der Seifenfabrikant, in Chem. Tr. Jour.*

THE LEANING TOWER AT SARAGOSSA.

THE world is not rich in leaning towers, and although, as Locke said of "Paradise Lost," they prove nothing, there are not a few people, such as archæologists and sightseers, who will be sorry to hear of their ranks being still further thinned. Recently we announced that it had been resolved to hasten the famous leaning tower of Saragossa in its secular progress from the perpendicular to the horizontal. Indeed, the wreckers are already at work, and it will not be many days before this architectural curiosity is resolved into its primitive building materials. Legend hath it that the vertical inclination of the tower, which deflects it about ten feet from the perpendicular, was a part of the original design of the builder. This, however, has been shown to be a mistake. Old prints are still extant in which the Torre Nueva stands as upright as that Prussian soldier whom Heine met on the German frontier, and of whom the poet maliciously opined that he had swallowed the stick with which Napoleon thrashed him at Jena. Moreover, when the tower was examined in 1860, it was fully established that its attitude was due to faulty foundations. In that year extensive works were undertaken with a view to arresting any further departure from the perpendicular, which it was felt would not be safe to passers by. It was fully restored, and it was then reported to be absolutely secure from further decline. Lately, however, it has been found that this belief was rather too sanguine, and hence the resolution to pull the tower down. For three hundred and eighty-eight years the Torre Nueva has been the pride of the Plaza



THE LEANING TOWER AT SARAGOSSA.

San Felipe in Saragossa, and one of the sights of the town. It is an octagonal clock tower, and one of the finest examples of its kind. The face of the structure is diapered with brickwork galleries, and at a distance it looks Moorish, but the design and execution are much coarser than in Moorish towers of the same dimensions. Its height measures 84 meters, while its base covers an area of 12 meters. It is mounted by a staircase of 280 steps, and in the campanile is another spiral ladder which leads to the crown-like balcony at the top, from which a glorious view of Saragossa and the surrounding country is obtained. In the main tower are several landings, each of which discloses a different aspect of the city.—*Daily Graphic.*

THE POPULAR IDEA OF THE DOCTOR TWO HUNDRED YEARS AGO AND NOW.*

By WM. MITCHELL BANKS, M.D. Edin., F.R.C.S. Eng., Surgeon to the Liverpool Royal Infirmary and Professor of Anatomy to the University College, Liverpool.

I WISH to address myself specially to those among you who are my fellow medical students. I call you so purposely, for, however old we may live to be, and however many degrees or diplomas we may succeed in obtaining, we shall still be students of medicine to the end of our days. What am I to say to you? Shall I tell you of the nobility of the profession which you have joined? Shall I speak to you of its astonishing advances—advances so amazing that many like myself who have seen some of the greatest of them never cease to marvel at them, albeit a day hardly passes without our making practical use of them? Have I anything new to tell you about the best way in which you may conduct your medical education and fit yourselves for your future life? I was thinking of all these things the other day when I chanced to open an album in which were the portraits of many of my old teachers. I have always been a confirmed hero worshiper. I am sure it does a young man good to have his heroes and adore them and be enthusiastic about them and believe that they can do no wrong. One of the faults I have to find with your modern Cambridge and Oxford man is that his motto is *nil admirari*. With him it is the height of good breeding to utter short sentences in a monotone, to preserve a frigid calmness, and to gaze with an equally stolid and bovine eye upon a drunken cabby or a transcendent genius. Only do his pulses quicken when he comes to the consideration of a shirt collar or "the nice conduct of a clouded cane." I confess I cannot bear a fellow who stifles his natural, hearty emotions like a man sitting on the safety valve of a boiler. To return, however, to the album. As I turned over its leaves I came to the portrait of Syme and looked at the keen, shrewd, somewhat stern face of the Napoleon of surgery, whom in my youth I had constituted my surgical hero, and whose memory I still revere. A few pages further on I came to a beautiful head—a head almost classic in its outlines, and surmounting a tall and stately frame. I recalled the gentle, tender eyes, and the mouth, which, when in repose, gave to the rest of the countenance a tinge of melancholy, but which, in happy moments, could shape itself into a smile of surpassing sweetness. The face was that of Warburton Begbie, physician to the Edinburgh infirmary. As a student one used to dream day dreams of the future. If ever I pictured myself as a great physician, when I looked closely into that picture it was the portrait of Begbie that I saw. So he became my medical hero. There are some here who will recall him as vividly as I do, and who can tell you for what good he influenced their lives by his own. Of his great eminence as a physician and of the quality of his contributions to scientific medicine I need say nothing. They are still fresh in the memory of those who are best able to estimate their value. As a teacher he had no rival in Edinburgh when I was a student. But while there have been many great physicians and many great clinical teachers, Begbie was not only both, but he was also the gentlest and most kindly of men. When he entered a ward a new light seemed to shine in the faces of the sick. In sooth, something to illuminate their lot was much needed in the dirty, dreary medical wards of the old Edinburgh infirmary. The very way in which he would put his hand on a patient's shoulder seemed to give the invalid comfort and strength. It was a great lesson to us young lads. We were full of health and life and hope; somewhat too apt to think that these sick people were only pathological curiosities and that we should never have trouble and disease like them. But there stood our master, who had seen much human suffering; who had had not a few trials to bear himself; and every day he taught us not only lessons in medicine, but lessons in courteous and considerate demeanor to the poor. I have always thought of him in my own mind as the gentle doctor, and I have always striven in the hospital wards and in the clinical theater to imitate his example. People have often said to me that after many years of surgical work a man must become case-hardened. What a mistake! The more blood a surgeon sheds, the more readily do the tears come into his eyes.

As I was musing about my old master it occurred to me that he was essentially a product of the present day and the current of my thoughts took me back a couple of centuries, which is about as far back as we know anything real about the lives and the manners and the customs of doctors. Before that time all is imagination and mystery. How could a comparison best be instituted between then and now? Probably by ascertaining what was and what is the popular idea of the medical man of the period. But who is to tell us? The novelist will. The dramatist will. The painter will. At any rate, so it has appeared to me, and I purpose to take one of each from the seventeenth century and one of each from our own day and see what they individually have to tell us about the doctor.

At the end of the seventeenth century lived Alain Rene Le Sage. He wrote the history of "Gil Blas." In it he has drawn a caricature of the doctors of the day. Doubtless it is a caricature, but after all, a caricature is only an exaggeration of the salient points of the individual portrayed. Sangrado is immortal. As long as there are doctors he will never die, and for all time, when anybody wants to poke malicious fun at us, Sangrado's memory will be used to poison the shaft of ridicule. You remember the description of him. "A tall, withered, wan executioner of the Sisters Three, who had done all their justice for at least these forty years. This learned forerunner of the undertaker had an aspect suited to his office: his words were weighed to a scruple, and his jargon sounded grand in the ears of the uninitiated. His arguments were mathematical demonstrations, and his opinions had the merit of originality." There was no doubt about the last statement, for after taking six good porringers of blood from the old licentiate Pedrillo, he says to Gil Blas: "It is a mere vulgar error that the blood is of any use in the system—the faster you draw it off, the better. A patient has nothing to do but to keep himself quiet; he has no more occasion for blood than a man in a trance. Drink, my children; health consists in the pliability and moisture of the parts. Drink water by pailfuls. It is a universal dissolvent: water liquefies all the salts. Is the course of the blood a little sluggish, this grand principle sets it forward. Too rapid, its career is checked." Let me recall to you the scene where the notary is summond to make the licentiate's will. "The notary," says Gil Blas, "was a dapper little fellow, who loved his joke, and he inquired who our physician was. At the name of Dr. Sangrado, hurrying on his cloak and hat, 'For mercy's sake,' cried he, 'let us set off with all possible speed, for this doctor dispatches business so fast that our fraternity cannot keep pace with him. That fellow spoils half my jobs.'"

We really must not part from Sangrado without one more touch. After Gil Blas has been Sangrado's partner for a while he becomes dismayed at the fearful mortality which their treatment seems to produce and says: "If you will take the hint, sir, we had better vary our system. Let us give, by way of experiment, chemical preparations to our patients. The worst they can do is to tread in the steps of our pure dilutions and our phlebotomizing evacuations."

"I would willingly give it a trial," rejoined the doctor, "if it were a matter of indifference, but I have published on the practice of bleeding and the use of drenches. Would you have me cut the throat of my own fame as an author?"

"Oh, you are in the right," resumed Gil Blas; "our enemies must not gain the triumph over us. They would say that you were out of conceit with your own systems and would ruin your reputation for consistence. Perish the people! Perish even the nobility and clergy, but let us go on in the old path."

This is all exquisitely funny, but in one sense it is very terrible reading, for it is obviously so true to the life. The English translation was made by Dr. Tobias Smollett. I wonder what he thought of Sangrado. After all, I do not suppose he considered it a very far-fetched description. Look at his own novel, "Roderick Random," written a hundred years later, and containing much of his own early experience as a surgeon's mate in the navy. Could anything be more degraded than the position of a very large section of the medical profession even at so much later a period?

Turning to the drama, it is somewhat curious to note that while Shakespeare, with the exception of the Apothecary in "Romeo and Juliet," hardly makes any allusion to medicine, Moliere constantly introduces medical characters into his plays. Sad to say, they were invariably brought in for the purpose of being satirized and held up to scorn. In his celebrated plays, "Le Malade Imaginaire" and "Le Medecin malgre lui," and in the smaller pieces, "Le Medecin Volant" and "L'Amour Medecin," he is so severe upon the doctors that he almost seeks an opportunity for excusing himself. In "Le Malade Imaginaire" he makes Argan, the imaginary invalid, say:

"Your Moliere, with his comedies, is a fine, impertinent fellow! I think it is like his impudence to go and bring upon the stage such worthy persons as the physicians." To which his brother Beralde replies, "He does not make fun of physicians, but of the ridiculousness of physic." Beralde is always very severe upon the medicos, and when his invalid brother says to him, "But doctors must believe in the truth of their art, inasmuch as they make use of it for themselves," he retorts: "That is because there are some of them who actually share in the popular errors by which they profit, and others who profit by them without sharing in them at all. Your Dr. Purgon, for instance, does not discriminate very clearly. He is a thoroughgoing physician from head to foot—a man who believes in his rules more than all the demonstrations of mathematics, and who would think it a crime to wish to examine them. He sees nothing obscure in physic, nothing dubious, nothing difficult. With an impetuosity of prejudice, a stiff-necked assurance, a coarse common sense and reasoning, he flies to bleeding and purging, and stops at nothing. You must not owe him a grudge for anything he might do to you, for he would dispatch you with the most implicit faith. In killing you he would only do to you what he has done to his own wife and children, and what, if there were any need, he would do to himself."

There is a most delicious interview between the in-

* Introductory address delivered at the Yorkshire College, Leeds.

valid and a certain Dr. Diafoirus, who is accompanied by his son, young Dr. Thomas Diafoirus.

Argand: Pray, sir, just tell me in what condition I am.

Dr. Diafoirus (feeling the pulse of Argand): Come, Thomas, take hold of the other arm of this gentleman, to see whether you can form a good judgment of his pulse. *Quid dicis.*

Thomas: *Dico* that this gentleman's pulse is the pulse of a man who is not in good health.

Dr. D.: Good.

Thom.: That it is hardish, not to say hard.

Dr. D.: Very well.

Thom.: That it acts by fits and starts.

Dr. D. *Bene.*

Thom.: And even a little irregular.

Dr. D.: *Optime.*

Thom.: Which is the sign of intemperature in the splenetic parenchyma, which means the milt.

Dr. D.: Very good.

Argand: No; Dr. Purgon says that it is my liver which is not right.

Dr. D.: Well! yes. Whoever says parenchyma says both the one and the other, on account of the close sympathy there is between them through the vas breve and the pylorus, and often through the meatus cholidici. He no doubt orders you to eat much roast meat.

Argand: No! nothing but boiled.

Dr. D.: Well! yes. Roast, boiled—the same thing. He prescribes very carefully for you, and you cannot be in better hands.

"Le Malade Imaginaire" closes with an interlude, a burlesque ceremony of admitting a doctor of medicine into the faculty. The stage directions, after describing the hall, say: "Then the whole assembly, composed of eight syringe bearers, six apothecaries, twenty-two doctors, and the person that is to be admitted physician, eight surgeons dancing and two singing, enter and take their places, each according to his rank." There is a president who invites members of the assembly to "heckle" the candidate. The whole is spoken in dog Latin, with an admixture of French, Italian and Spanish that is extremely diverting, but quite untranslatable. Whatever be the question, the candidate has only one answer, "Clysterium donare, Postea seignare, Ensuita purgare," and at once the chorus bursts out into "Bene, bene, bene respondere: Dignus, dignus est intrare, In nostro docto corpore." One doctor propounds a case to him with the usual answer. "But what is to be done if the case won't get well?" says the examiner. "Reseignare, repurgare et reclysterisare," cries the candidate, while the chorus roar out, "Bene, bene, bene, bene respondere." Finally, clapping the doctor's bonnet on the bachelor's head, the president gives him his license to practice, with the right of physicking, purging, bleeding, piercing, slashing, cutting and killing throughout the whole land. "Ego, cum isto boneto Venerabili et docto, Dono tibi et concedo Virtutem et puissanciam Medicandi, Purgandi, Seignandi, Percandi, Taillandi, Coupandi Et occidendi Impune per totam terram." The whole interlude constitutes perhaps the funniest satire on medicine that ever was written.

Now for the painters. In the house of a friend of mine hangs an old engraving by Nanteuil called "Le Bassin." It is a representation of a doctor holding in one hand an earthenware vessel containing excreta of some sort, to which he is solemnly pointing with the forefinger of the other. He wears a gown. His head is adorned with a kind of big flat cap, from beneath which flows his long hair. Round his neck is a fur collar, and large white bands hang from below his chin. His eyeglasses are somewhat awry on his nose, and he is evidently giving forth some portentous prognostication as the result of his examination. A glance shows him the incarnation of quackery. Beneath the picture are some verses in old French, the sense of which may be expressed thus:

> Doctor! this precious mess test well,
> And from its savor, from its smell
> Your prophecies declare.
> Your skill should soon procure at least
> A burial service for the priest,
> Whose fees you'll gayly share.*

The same form of scarcasm is seen in the famous picture, "La Femme Hydropique," and in many other productions of the Dutch and Flemish artists. It comes out at a much more recent date in the savage caricatrues of Gillray. I saw one the other day in which the peasants of a village are represented shooting their rubbish. A great crowd follows three wheelbarrows in which three individuals are being wheeled away. In the first is an attenuated wretch with bag and papers—the lawyer. In the last is a great fat figure with full bottomed wig and gouty leg done up in flannel—the parson. In the middle barrow, with three cornered hat on head and still grasping his squirts and bottles, sits the doctor.

Now, while we have the idea of the seventeenth century doctor fresh in our heads, let us leave two centuries behind and come to our own day. What says the modern novelist? If you want to read a charming book, go and buy Le Docteur Rameau, by George Ohnet, one of the few French authors who do not consider it essential that the chief constituent in a novel should be literary ordure—which is considered a great crime in him by those mandarins the Parisian critics.

The doctor is of the humblest origin, the son of a railway *employé* in the country. One day a terrible collision occurs near his father's hut. Although only fourteen, he displays such energy in helping the village surgeon, Dr. Servant, to succor the wounded that the latter sees his genius. He gets him put to school, and, in due time, with the aid of scholarships, gained by his indomitable hard work, Rameau has his choice of going to the Ecole Polytechnique or to the Ecole Normale. Here his benefactor, Servant, steps in and says to him, "Do thou be a doctor. What I have given to thee give back to thy fellow beings. That genius, which is undeniable in thee, place it at the service of humanity." When he comes on the scene Rameau has reached the highest grade in his profession. He is a professor and operator of renown, in great request as a consultant and a famous clinical teacher. Here is the description of him: "Fifty years of age, with a vigorous constitution never weakened by any excesses, Rameau is a man of great stature, with a visage rugged as a volcanic soil. His big forehead is crowned with gray hair, wavy and coarse, like the mane of an old lion. His gray eyes, clear and piercing as his own steel instruments, are surmounted by eyebrows black and shaggy. A ruddy complexion tells of blood boiling with the activity of a life absolutely devoted to toil, and his thick-lipped mouth breathes of kindness. But there is a deep wrinkle at the root of the nose, furrowed between the eyebrows, and when he is profoundly occupied or when he is annoyed this wrinkle gives him a fearsome look. At the hospital or in the amphitheater, when the word is passed that 'Rameau has got his wrinkle,' it is a storm signal for the house surgeons and pupils. Not a man but trembles and holds his peace when that fearful furrow comes over the usually genial brow of the *savant*, for his bursts of passion are formidable and nothing can stop them. His roughness is as well known as his skill. No woman ever put on a dressing or adjusted a bandage with a lighter hand or more dexterous fingers; no carter ever swore at his horses more furiously than the doctor at his assistants. The frightened patients get under the bed clothes or bury their heads in the pillows when they hear the thundering voice of the surgeon as he flourishes with a menacing air some sharp-bladed instrument. He does what has to be done for them; and then transported with joy, the poor things, more dead than alive, learn that the operation, which they fear has hardly begun, is already over and finished. Then it is that they bless the skill of that kindly carver and come to know why it is that the house surgeons and pupils laughingly say behind his back, 'It's only Rameau's tongue that ever hurts his patients.' Without doubt, the confidence which he inspires accounts for half the success of his treatment. It is so well established that the presence of Rameau by the bedside of a sick man puts death to rout that at the first glimpse of the doctor as he comes in the patient feels himself saved. No great person in the land ever has a serious illness without Rameau being summoned, at whatever cost. When the Innspruck surgeons wanted to cut off the Archduke Charles' leg, after he had fallen into a ravine chasing the blackcock, it was owing to his skill and ingenuity that the prince was saved from being a lifelong invalid. For his trouble he demanded a hundred thousand thalers. He once went to operate on Garibaldi for a phlegmon, which was seriously endangering his life. He asked from the grand old adventurer, as a fee, a flower from his garden. Rameau is a democrat and a free thinker—a democrat because, sprung from the people, he has inherited their bitter notions about equality; a free thinker because in his profound scientific researches he has only encountered at the end of his scalpel mere matter, and because his powerful mind refuses to admit what it cannot explain."

Is not this a delightful description of a modern French doctor by a modern French novelist? I think you will forgive me quoting for you a charming incident. There are two ladies, widowed mother and daughter, who have been reduced from affluence to poverty and barely eke out an existence by dressmaking. Their old servant Rosalie still clings to them. The mother takes ill and is at the point of death, and the daughter's anguish is terrible. Then the servant Rosalie invades the crowded consulting room of Rameau. She is arguing with the manservant, who is telling her that the doctor cannot possibly see her till the following day. Then comes this scene:

"The sound of a bell interrupted the talk and, without giving a thought to the distressed woman, the manservant opened a door and proceeded to let out the person who was leaving the consulting room. In the half light of the waning day the tall figure of Rameau appeared. Some brief parting words were exchanged between the doctor and his patient. The woman, who was weeping, had raised her head. With the intuition of grief she divined in that unknown, barely visible person the saviour she had come to implore, and, rising sharply, she precipitated herself after him into the room. Rameau did not hinder her, but looked her all over with a smile.

"'What is it, my good woman?' he said, in his deep, grave tones.

"'Oh! my dear sir! Surely you are Dr. Rameau; are you not?'

"'Yes, I am.'

"'Then it must be Providence that has permitted me to reach you. Ah! Great Heaven! your servant was just telling me that I must either wait or come back to-morrow. As if death would wait!'

"'Death?'

"'Yes, my dear, good sir; our doctor has said so. It is a question of hours. If the operation is not done this very evening, my mistress will never get over the night. And we heard that it was only you that could save her. Then mademoiselle said to me: "Run for Dr. Rameau and bring him. Ah! Dieu! promise him what you like; we shall sell the furniture, if necessary, to pay. Only let him save mother!"'

"Rameau knit his brows. The woman saw a cloud pass over the face of the *savant*. She reddened and stopped, quite confused.

"'Forgive me,' she cried, 'I am so troubled that I say anything that comes first; but I am indeed sorry to have offended you.'

"Rameau made a careless gesture.

"'Are your mistresses, then, poor?' he asked.

"'Alas! Yes! The dear ladies! After having been in such an excellent position, too, distress is all the more painful for them. But so good, one would be cut in pieces for them. And mademoiselle, so sweet and so beautiful. Ah! doctor! if you only knew her!'

"'Well, now, what's the matter with your invalid?'

"'Oh! some sort of gangrene. At first they treated her for rheumatism in the shoulder, and then, day after day, they have seen her steadily going from bad to worse. Ah! sir! if she had been rich, as she once was, they wouldn't have let her go to the last gasp. But the poor! They can die. Isn't that so?'

"Rameau threw back his head, and very gently replied, 'No, my good woman.'

Then he calls his carriage and goes out with her, leaving the rich occupants of the crowded ante-chamber to come next day. He cures the mother and marries the beautiful m'amselle. After some years his wife dies, leaving him a daughter, and terrible griefs and calamities accumulate around him. Still he obstinately remains a disbeliever and an atheist, and under the burden of his sore troubles he only becomes more and more defiant and obdurate. His miseries culminate in what threatens to be the fatal illness of the beloved child. But she recovers and marries her father's assistant, and the story closes with a beautiful scene in the church at the marriage. Beside Rameau sits his old and faithful friend Talvanne, who has stood by him through all his troubles.

"At that moment, with measured steps, the priest descended from the altar to unite the young couple. Adrienne's uplifted veil allowed her countenance to be seen bent down in fervent prayer. At the question, 'Do you take for your husband so and so?' she answered with a clear tone, 'Yes;' and her gaze, turned a little sideways, riveted itself on her father as if to offer to him all that happiness which filled her. That look expressed a tenderness so profound that it penetrated Rameau to the heart. At the same instant the sun streaming through the windows of the choir kissed with its rays Adrienne's yellow hair and lit it up as with a golden glory. So she appeared as if transfigured, almost isolated in a divine luminosity, like some young saint come down among men. In her Rameau beheld an angel sent to him to console him for all his miseries. All that remained in him of bitterness or pain melted away in a delicious ecstasy, and, full of humble gratitude, he knelt down. Talvanne, hearing him speak in a low tone, leaned over to listen and heard these words murmured with fervor, 'My God! My God!' It was the atheist who was praying."

And now, how do they put the doctor on the stage nowadays? The other night I went to the theater to find out. I went to see Sydney Grundy's play, the "Fool's Paradise," in which the chief part, that of Sir Peter Lund, the physician, is played by my old friend, Mr. John Hare. In a character of this sort Mr. Hare has admittedly no rival in this country, and therefore it need hardly be said that the part was played to perfection. Doubtless many of you have seen the play, and will remember the admirable make-up of the old doctor, who obstinately keeps up, even in his dress, the traditions of his youth. He is brusque and dictatorial, but there is a total absence of solemn pretentiousness about him. He affects not to know anything, and would have you believe him to be a sort of medical agnostic. He actually delights in making fun of his own profession. But he has not uttered half a dozen sentences before you see that he is a shrewd man of the world, who has mixed with every class of society, from the peer to the pauper. He knows that drugging is for the most part useless, and says so; only the public will have drugs, and do not believe in a doctor who talks common sense to them. There are some capital bits of humor in the conversations between Sir Peter and his patient Philip, whose mysterious case he is quietly and accurately fathoming, while affecting all the while to talk nonsense to him. Sir Peter says to him:

Well! what's the matter with you?

Phil.: Really, Sir Peter, that's what I want you to tell me.

Sir P.: You have a high opinion of the medical profession. Do you suppose we can tell you anything if you don't tell it us first?

Phil.: I have always supposed so.

Sir P.: Error, sir. You tell us everything we tell you. The only difference is you tell us in English and we tell you in Latin. You take a fee out of your pocket; we put it in ours.

Phil.: You are plain spoken, Sir Peter. Now, tell me with equal candor, what is the matter with me.

Sir P.: Shall I tell you the truth?

Phil.: Of course.

Sir P.: I don't know.

Phil.: Surely with your experience——

Sir P.: Sir, I have no experience.

Phil.: Well, with your knowledge——

Sir P.: Sir, I have no knowledge. Knowledge is the monopoly of extremely young practitioners. I have been doctoring for forty years, and now I stand here on your hearthrug, sir, a monument of triumphant ignorance.

Phil.: Nonsense, Sir Peter.

Sir P.: Sense, sir, sense.

Phil.: Be candid and tell me frankly what is wrong with me.

Sir P.: Your liver, probably.

Phil.: Only my liver!

Sir P.: Don't speak disparagingly of your liver, sir. That eminently respectable organ has been much misunderstood. It is commonly supposed to serve certain functional purposes in the physical economy. Another fallacy! The liver was made by a beautiful provision of nature for the benefit of the medical profession.

During the play I watched the audience to see what they thought of Sir Peter. They evidently liked him very much. They enjoyed him. In one scene the wicked wife, who does not wish him to prolong his stay in the house, says to him: "But what will your patients do without you, Sir Peter?" "Recover," he answers, and bolts out of the room. This amused them amazingly. But why did they like him? I am certain they liked him for his honesty and his kind-heartedness. In spite of his odd ways and affected cynicism, one could see that he was a genuine, true friend, and, in his own heart, was oppressed with anxiety for the safety of his friend and patient. And when the time came for a terrible disclosure and he had to denounce the miserable wife as the poisoner of her husband, he rose to the occasion. There was no affected cynicism in the sharp, clear voice with which he said, "I suspected you from the beginning." He stood out a courageous old man, prepared to do and say anything for the right.

Finally, we come to the painter of to-day. It will not be denied that the picture of 1891, the one which stood out clearly and prominently above all the other pictures of the year, was Mr. Luke Fildes' "Doctor." Of the hundreds of medical men who must have stood before that picture I am sure there was not one whose pulses it did not quicken with pleasurable pride, or who left it without thinking that it already

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* De ce mets precieux goute, friand Docteur,
De son odeur, de ce savour
Tire d'infaillibles presages,
Vol si ton Art aura promptement procure
Des *De Profundis* de cure
Avec qui gaiement tu partages.

had been, and again would be, his privilege to fight against pain and suffering and death like his colleague on the canvas. For to us he is a real living man like ourselves. We have acted like him and felt like him.

Note where the scene of the picture is laid—not in some rich man's mansion, where the doctor might reasonably expect a handsome fee for his trouble, but in a workingman's cottage, where most likely the gratitude of the people and a consciousness of having done his duty by the poor would be his sole honorarium. With admirable skill the painter has pitched on the early hour of morning for the time. The light of the lamp in the room and the light of the dawn coming through the casement are struggling with each other. It is the cold sad hour when human vitality is the lowest, and when statistics tell us most men die. The sick child, worn with the raging fever that commonly burns from eight in the evening till one or two in the morning, lies spent and exhausted. Till then the parents have been fighting on with their nursing; soothing, caressing, encouraging their little one. But now they too are exhausted and depressed, and hoping against hope seems all that is left to them. And there sits their friend—the gentle doctor—watching with them, and still puzzling his brains to think what more he can devise to stay the lamp of life from flickering out. He is no courtly physician. He is only a country doctor, but his somewhat rugged face tells of honesty and common sense and self-reliance and gentleness. What more do you want? The men that look like that man, whatever be their business or trade or profession, whatever be their wealth or their social position, I say, of such men is the kingdom of heaven.

Let us, then, take a review of the whole matter. This much is clear, that when a personification of the doctor was presented to the public two hundred years ago, he was invariably held up to ridicule as a quack. He was a man who pretended to a knowledge he did not possess—by consequence a man whose life was one continual fraud. His language was inflated and bombastical, and his sesquipedalian words were employed to distract attention from the unintelligible and idiotic ideas which they concealed. Having a love for collecting old medical books, I have dipped a good deal into them. Often, after coming to the bottom of a page, I have read it again, and if it had been written by any lunatic in Bedlam it could not have been more absurd or vacuous. The word "experiment" was almost unknown. If there arose a question as to whether some particular thing was blue or red, men did not go to find it and see with their own eyes whether it was blue or red, but they sat in their closets and argued about it. I must admit that, if the doctors of that day were always presented to the public as quacks, they did their best to deserve it. The next thing that is clear is that they were overbearing, greedy, hard-hearted quacks. Never once are we shown one of them doing a good or kind action. The doctor is an impostor, whose sole object is to get his fee. That fee he must have if the wretched patient has to sell his shirt off his back for it. Such, I assert, is the impression which must be conveyed to the mind of anybody who reads the novels or dramas or looks at the pictures or caricatures of the seventeenth century. But were all those old doctors like this? No; most certainly not. There were splendid men among them. Look at the names of Morgagni and Bartholin, and Willis and Sydenham and Malpighi, among many others. These men had as great patience, as keen wits, as unselfish motives, and probably more courageous hearts than any of our scientific men of today. Their labors and discoveries were as great and as important as our own. We are every day making use of their work, just as the twentieth century doctors will make use of ours. But they were in a small minority. Their bright and glorious example had not descended. The rank and file of the profession were still the greedy quacks that Le Sage and Moliere and the Dutch artists painted. Moliere has been accused of having been too severe upon the doctors of his day, but no ridicule can be too severe when it is employed to expose the humbug and the charlatan. To him, as a profession, we are under an eternal debt of gratitude. As a body we were sick men. His physic was bitter enough in all conscience, but it took hold of the disease and cleansed away many of our impurities.

Turn we now to the picture of to-day. Whatever be the shortcomings and weaknesses which the doctor has, in common with all his fellow-men, they are not now seized upon and savagely caricatured and grotesqued to amuse a jaded public. Nobody makes more fun of us than *Punch*. But his fun is always so genial and good humored that, when a medico forms the principal figure in one of his pictures, the medicos eagerly buy the paper to enjoy the joke. And when a doctor has done some self-sacrificing bit of heroism, who so ready to sing his praises as our dear old friend *Punch*? If you go to the theater you will see that the people like Sir Peter Lund. His *brusquerie*, his pretended cynicism, and his real tender-heartedness please them. They admire his honesty and fearlessness when the moment of decisive action arrives, and they are amused with the keenness and shrewdness which a long acquaintance with men and things has given him.

And, finally, tell me a picture that has ever appealed more powerfully to the public than Mr. Fildes' great work? Naturally it has had to run the gauntlet of severe criticism; but to attract criticism is in itself a sign of the inherent value of a thing. As to the technical merits of the picture, I say nothing. Artists are the proper judges of that. But when they accuse the painter of false sentiment, I join issue with them at once. To my mind a picture is falsely sentimental when the artist represents in it a scene or situation which does not occur, and is consequently unreal, with the object of eliciting our sympathy and our more tender emotions. But the situation represented in "The Doctor" is not an unreal one. It is a painfully common and real one. It is one which occurs continually in our lives. Would that I had some Asmodeus to lift off the roofs of the houses of Great Britain to-night and to take these critics to where life and death are engaged in the final contest for the mastery. They would see to-night—this very night—Luke Fildes' doctor sitting by the bedside watching for every deeper breath, every stronger pulse that might give him hope to go on with the fight. They would see the country doctor in the Highland cottage or the Yorkshire farmhouse. They would see the physician of renown in some great nobleman's palace. They would see the house surgeon in the hospital ward. But, in whatever capacity he might be revealed, of this I am sure, that he would be seen overmastered by the one idea of how to save his patient and how to show himself the gentle comforter of the afflicted friends. I have just said that we owe much to Moliere for lashing out of us the quackery and ignorance that prevailed in his day. But what do we not owe to Mr. Fildes for showing to the world the typical doctor, as we would all like him to be shown—an honest man and a gentle man, doing his best to relieve suffering? A library of books written in our honor would not do what this picture has done and will do for the medical profession in making the hearts of our fellow men warm to us with confidence and affection.

And now, my dear young friends, we are nearing the end of the nineteenth and you will be the doctors of the twentieth century. Upon you will devolve the responsibility of maintaining that honorable position in the sight of all men which your forefathers have struggled to win for the profession of their choice. You are no longer students of a mere provincial school of medicine. You are members of a college of a university which, before your days are ended, will have revolutionized education in the north of England. The ground has been prepared and planted and watered, and you are the first fruits. Yours it is to bring forth an abundant harvest of good works, not merely for the credit of your profession, but for the glory of your *alma mater*. You must copy the intense industry, the resolute will, the single-eyed devotion to science of Doctor Rameau. You must, like Sir Peter Lund, learn to be wise as serpents as well as gentle as doves, so that you may bring to bear upon your patients' cases not merely a knowledge of morbid anatomy and drugs, but also a knowledge of the ways of the world and of the inner workings of men's lives. But, above everything, whatever may be the rank in your profession to which you may attain, remember always to hold before you the ideal figure of Luke Fildes' picture, and be at once gentle men and gentle doctors.

I take my farewell of you in the words with which Moliere's president opens the examination function for the bachelor of medicine:

Savantissimi Doctores,
Medicinæ Professores,
Qui hic assemblati estis;
Et vos, altri messiores,
Sententiarum Facultatis
Fideles executores.
Chirurgiani et apothecari,
Atque tota compania aussi,
Salus, honor et argentum
Atque bonum appetitum.

—*The Lancet.*

SCHOOL OF PHARMACY—MAJOR EXAMINATION.

Questions set by the Board of Examiners for England and Wales to October, 1892, candidates, to which are appended model answers.

PHYSICS.

(Time allowed: Three hours.)

Question 1. *Give an account of dialysis and its use. Can the process be explained?*

Answer.—Dialysis has been defined as "the separation of dissolved substances from each other by taking advantage of the different rates at which they pass through moist diaphragms or septa." A classification of soluble substances has been devised based on the greater or less readiness with which they pass through a diaphragm of parchment paper or other similar material. Those which pass through with facility are called "crystalloids," because the majority of the members of this class are capable of assuming the crystalline form. Those which refuse to pass or pass very slowly are called "colloids," a term literally meaning "glue-like," because gelatine is the most perfect example of this class. In order to apply the process of dialysis the liquid containing the substances to be dialyzed is placed in a *dialyzer*, an apparatus consisting of a hoop of glass or guttapercha over which a piece of parchment paper is tightly stretched and secured in this position by tying or otherwise. The dialyzer is next floated or suspended in a vessel of pure water and the process commences. The crystalloid substances pass through into the water, while the colloid bodies remain in the dialyzer. As one illustration of the use of the process may be mentioned the preparation of the *liquor ferri dialysatus* of the B. P., in which the colloidal portion is retained. Again, in the analysis of complex organic mixtures the process is often used. Crystalline poisons, for example, are by this means separable from inert and indefinite organic matter. Attempts have been made to explain the phenomenon by supposing that the molecules of a dissolved body have a motion of their own among the molecules of the solvent somewhat analogous to that of the molecules of gases. By the further supposition that this molecular motion varies in velocity in the cases of different substances—that it is rapid with highly crystalloid bodies, and becomes more and more sluggish as we advance toward the typical colloids—the process of dialysis receives a, at least, provisional explanation.

Question 2. *A beaker containing water at 15° C. with a thermometer in it, is placed in a freezing mixture at — 5° C. Follow the indications of the thermometer and the other physical conditions in the water, up to the time when it reaches the temperature of the freezing mixture.*

Answer.—The water in the beaker would at once commence to cool, as would be rendered evident by the steady fall in the thermometer, and this cooling would be accompanied by a diminution in volume. At a temperature exceedingly near 4° C. this contraction would cease and the water would begin to expand, while the thermometer would still continue to fall until the temperature of 0° was reached. At this point congelation would probably commence, and the thermometer would remain stationary until this congelation was completed. The water in the act of conversion into ice would undergo a *large* and *sudden* increase of volume, not to be confounded with the slow and comparatively insignificant one taking place between 4° and 0°. The water once entirely frozen, the thermometer would again begin to fall, and would fall more rapidly than while the water was still liquid. The fall would continue till the temperature of the freezing mixture was attained, the ice at the same time contracting slowly and slightly in volume. It might, however, happen that the temperature fell below 0° without freezing occurring, especially if the liquid were kept quite free from agitation. A slight stirring of the water, or the dropping in of a minute ice crystal, would at once determine the congelation of the water. The thermometer would in this case rise to 0° and remain there till solidification was complete; the remaining phenomena would then take place as before described.

Question 3. *Define specific heat, and give a process by which it may be determined. What is its relation to atomic weight?*

Answer.—The specific heat of a substance may be defined as the ratio of the heat required to raise the temperature of unit mass of that substance through unit interval of temperature to the heat required to raise unit weight of cold water through the same interval. Of the methods employed in determining the specific heat of substances the following is, perhaps, the most generally useful. A known mass of the body, which we will presume to be a solid, is heated to a known temperature and then plunged into a known mass of water at a different, but also known, temperature, and contained in a *calorimeter*. Time being allowed for a common temperature to be reached, this is carefully taken by a delicate thermometer, and the specific heat may then be easily calculated. For it is evident that the heat lost by the body is equal to that gained by the water, and, again, the heat lost by the body is the product of its mass into its specific heat into its fall in temperature, while that gained by the water is equal to its mass multiplied by its specific heat (*i. e.*, by unity) and by its rise in temperature. We thus obtain an equation from which the specific heat of the body is readily obtained. In actual practice it is necessary to take several other data into account—for example, allowance must be made for the heat absorbed by the calorimeter, the stirrer, and the thermometer, as also for that lost by radiation during the experiment. It will be scarcely necessary to add that modifications in the process are rendered necessary when a liquid or a gas is to be experimented upon.

The curious relationship existing between the specific heat and the atomic weights of the elements was discovered by Dulong and Petit, and may be expressed as follows: "The product of the specific heat of an element into its atomic weight is an approximately constant quantity, the mean value of which is 6·4." At first several elements were considered to exhibit exceptions to this law, but subsequent researches have shown most of these exceptions to be apparent rather than real.

Question 4. *Describe the construction, use, and principle of the electrophorus. What is meant by an "influence machine"?*

Answer.—The electrophorus consists of a cake of resin or guttapercha resting on a metallic base called the sole and provided with a metallic cover fitted with an insulating handle. Before using it care should be taken that all its parts are dry and moderately warm. The cake is excited by rubbing or striking it with fur or flannel, and the cover placed upon it. If the insulating handle be now grasped by one hand while a finger of the other is placed for an instant upon the upper surface of the cover, on lifting the latter by its handle a spark can be obtained by approximating the finger or other conducting body to the edge of the disk. Replacing the cover upon the cake, again touching with the finger, and removing as before, a second spark may be obtained, and this may be repeated a great number of times. The theory of action is as follows: The resinous cake becomes charged with negative electricity as a result of the friction with the fur, and when the cover is touched with the finger, and so connected with the earth, an opposite charge is induced in it. Another way of expressing the same thing is to say that the negative electricity of the cake attracts to the under surface of the disk positive, and repels to the upper surface negative, electricity. This latter is conducted away through the finger while the former remains "bound." The energy manifested in the spark has its origin in the excess of the muscular effort required to raise the cover against the attractive power of the cake over that which would be needed were there no electrical excitation. An influence machine is a species of revolving electrophorus in which an electrified body acts by induction upon a revolving system and gives rise to a continuous electrical production. One of the best is that of Wimshurst.

Question 5. *Give a short account of (a) the arc lamp and (b) the glow lamp, and trace the transformation of energy exemplified in the production of the electric light by the usual method.*

Answer. (*a*) In the arc lamp electric discharge takes place between two pieces of hard conducting carbon separated from each other by an interval which, by various ingenious devices, is kept as nearly as possible constant. An arc of light of intense brilliance is thus obtained called the voltaic arc. The carbons, being raised to an exceedingly high temperature and exposed to the air, suffer waste by combustion, and hence require renewal. There is also a transference of particles in the direction of the current, the negative carbon increasing at the expense of the positive one. With the view of obviating inconveniences arising from this cause, arrangements are often made for alternating the direction of the current. A globe of ground glass serves to diffuse the light and to lessen its otherwise painful intensity.

(*b*) In the glow lamp a filament of carbon inclosed in a globe exhausted of air by a mercury pump is interposed in the path of the current. The resistance experienced in passing through this filament is sufficient to raise it to incandescence, and a light is thus obtained more suitable for domestic purposes and the illumination of interiors generally than that afforded by the arc lamp.

The energy manifested in the electric light as usually produced is derived from the heat generated by the combustion of coal or other fuel. This is transformed by means of a steam engine into mechanical power, and this again into electricity by the dynamo-

electric machine. The current is again converted into heat when it meets with resistance in its path, and thus the excessively high temperature of the carbon in the previously described lamps is produced. The radiation from this heated carbon constitutes what we call the electric light.

Question 6. *What is monochromatic light? Show how it may be obtained, and name some of its uses in physical investigations.*

Answer. Absolutely homogeneous or monochromatic light would be composed of light waves all possessing the same wave length. In practice the name is given to any light which closely approximates to this condition. It differs from compound light in being invariably colored, which compound light may or not be, and in being unable to be split up into constituent lights of different colors. A ready and convenient method of obtaining a monochromatic light is by burning alcohol impregnated with sodium chloride in a suitable lamp. Monochromatic light is used in determining the rotary power of optically active bodies, and also in investigating refractive indices.

THE PLANET VENUS.

M. E. L. TROUVELOT has published a most important and extensive paper on some observations of the planets Venus and Mercury, which for many years past have been occupying his attention. The physical features of the other planets have been treated on previous occasions in like manner, and have extended our knowledge very considerably, so that the reader of this work will be sure to find something really new in the great number of observations that are here recorded. Up to the month of April, 1882, the observations were made at Cambridge, United States; but since then Meudon has been the seat of operations; the air at the latter place did not prove so pure as that in the States, and the horizon not being so open, the number of observations of course was somewhat reduced.

In the work which we have before us the author divides this subject up into nine sections, and we cannot do better than treat of each of them in turn, commencing with the visibility of Venus to the naked eye in full daylight. The best way is, he says, to use the telescope as a pointer, directing it to her by means of the circles; by then looking along the telescope tube he has been able to see her at every point of her orbit, when her angular distance from the sun toward inferior conjunction was not less than 10°, and also toward superior conjunction when she was not less than 5°. Her visibility depended to some extent on the phase she represented, for it is known that the eye can distinguish more easily a disk small and distant than a comparatively larger and nearer crescent. At Cambridge it seems to have been more or less the rule, while at Meudon it was the exception, to see Venus in the daytime, the atmospheric conditions at the latter place being comparatively very bad.

With regard to the general aspect of Venus nothing very striking has been noticed; the part of the limb turned toward the sun, as recorded by other observers, always appeared more brilliant than the more central portions extending toward the terminator. Sometimes the limb was not so bright as usual, being observed to be "dull and without brilliancy," one very noticeable time occurring on April 15, 1878.

Under favorable conditions, whitish and grayish spots can be seen on the surface of Venus, which, at any time, are very difficult to observe. These different tinted spots give, according to M. Trouvelot, indications of being at different levels. The whitish spots, situated near the terminator, produce on it slight deformations, and seem to so alter it as to suggest that these spots are at a higher level than the other parts. The grayish spots, on the other hand, when situated in about the same positions, also deform the terminator to a small extent, but in an opposite way to those just mentioned, suggesting that these spots lie at a lower level than the parts near them. These two kinds of spots have another peculiarity which has been particularly noticed, and that is their size; the white ones seem to assume a round or slightly oval form, and are nearly always small, but the gray spots are generally of an elongated shape, and are of very large proportions, forming sometimes straight bands. The interval between the appearance and disappearance of these spots is not long; in their formation they are analogous, as M. Trouvelot says, "avec ces taches diffuses des couches nuageuses continues de notre atmosphere précedent les pluies, et qu'un simple jeu de lumiere fait naitre ou disparaitre." Their contours are always very vague, the whites being a little less brilliant and the grays a little less dark.

One of the largest spots that has been diligently observed was that which appeared on September 3, 1876.

FIG. 1.—SHOWING THE LARGE SPOT ON SEPTEMBER 3, 1876.

Its size, as will be seen from the figure, was, comparatively speaking, enormous, occupying nearly a third of the illuminated visible surface. At its north and south extremities it was separated from the terminator by a large white band, the north one being considerably larger than the southern one. Up to the 10th of the same month this spot was still visible, but after that date no trace of it at all could be found. Curiously enough, on February 13, 1891, another large gray spot (Fig. 2), bordered with white, made its appearance,

FIG. 2.—LARGE SPOT VISIBLE ON FEBRUARY 18, 1891.

and was very similar to the one we have just mentioned, both with regard to its position and form—indeed, the resemblance was so striking that the spots were considered the same. Why it should have disappeared so soon in 1876 and become visible again in 1891 is a mystery which is hard to fathom.

Perhaps one of the most interesting features visible on the surface of Venus are the two snow caps (Figs. 3 and 4) at the extremities of her poles. These spots, as

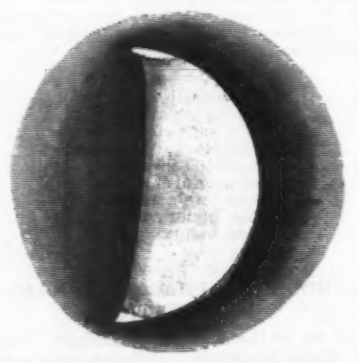


FIG. 3.—THE SNOW CAPS, FEBRUARY 20, 1891. 10 H. 45 M.

M. Trouvelot says, surpass in brilliancy and importance all that he has ever observed. In 1877, on November 13, a white spot was seen at the north limit of Venus; its brilliancy attracted considerable attention, resembling very much those situated on Mars. On the following day, another spot, also very striking and of the same character, diametrically opposed, was observed. The question then arose as to the cause of these spots, and we may here quote an entry that was

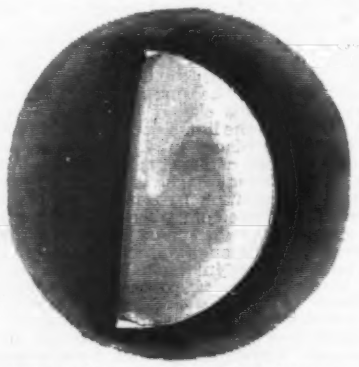


FIG. 4.—THE SNOW CAPS, FEBRUARY 25, 1891. 10 H. 15 M.

written in the observer's book on the 17th of the same month: "Est-ce que Vénus aurait des taches blanches semblables aux taches polaires de Mars?" The seeing of these spots was by no means a difficult task, and it seemed certain that if they were snow caps, as suggested, perhaps they had been previously observed. This was the case. On June 9 and 17, July 20, August 1 and 27, 1876, and February 5, 1877, observations of these spots had been recorded in the note book, but, owing to their not having attracted very great attention at the time, they were regarded as ordinary spots. That they are analogous to the white spots on Mars is now undoubted; they have the form of a uniform white segment of a circle, which, when seen edgeways, appear as simple lines; they are always exactly 180° apart; sometimes only one is seen, because the other is not lighted up by the sun; they are always approximately near the terminator, and seem to oscillate backward and forward, balanced, so to speak, around the axis of the planet; and, lastly, they are of a permanent nature, their disappearances being due not to their annihilation, but simply to the fact that they cannot be seen when receiving no light upon them. One main feature in which they differ from the spots on Mars is that they neither increase nor decrease with the seasons, at any rate to a sufficient extent to be sensibly noticed.

When Venus is in a favorable position for observation many details on these spots have been recorded. M. Trouvelot mentions here some bright spots (Figs. 5 and 6), which seem to be very numerous, and resemble the bright specks which are seen on the terminator of

FIG. 5.—DETAILS ON THE SNOW CAPS, JANUARY 19, 1878.

the moon, "sinon qu'elles sont plus brilliantes, surtout sur leur bord interne, et qu'au lieu de petits cratères, elles sont entièrement couvertes et hérissées de pics et d'aiguilles, qui, parfois, réfléchissent la lumière avec une si grande intensité, que ce bord apparait tout constellé d'étoiles alignées comme les grains d'un collier de pierres précieuses, sans quelques irrégularités dans cet alignement." The whole appearance seems to suggest that the spots are at a higher level than the contiguous parts of the planet situated at the edge. This idea is also further borne out when the phase of the planet is a small crescent, for then much more of the polar cap is found to be visible than should be the case if the form of the phase were an exact crescent. In many cases a penumbra has distinctly been seen, and in one of them it was so strong and distinct

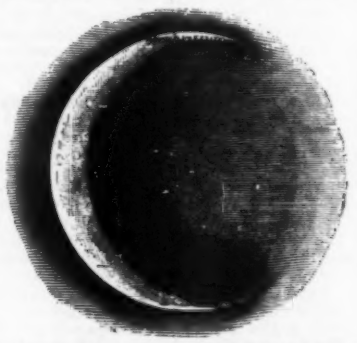


FIG. 6.—THE SNOW CAPS, FEBRUARY 5, 1878.

on that part of the terminator lying between the two polar caps that it lasted for a month, the spots remaining clear and brilliant throughout their entire length. Ever since the year 1700, observers of Venus have remarked these two spots that occupy the polar regions. La Hire and Derham, observing the inequalities of the surface at the extremities of the crescent, believed that they could be produced by mountains higher than those on the moon. Bianchini at Rome, Schroeter, Gruithuisen, and several others, all have reported the existence of such markings, but they were never led to conclude that they were snow caps analogous to those on Mars.

To obtain a general idea of the ruggedness and smoothness of the planet's surface, the terminator has helped to considerably distinguish the high and low elevations and depressions respectively. The surface of Venus from such observations as these has been found to be considerably studded not only with small, but with great differences of configuration, the terminator varying greatly in many phases of the planet. M. Trouvelot's results show that these deformations become most apparent when Venus is at her greatest eastern and western elongations. Sometimes one half of the terminator is seen concave, while at the same time the other is convex (Fig. 7); small indentations at

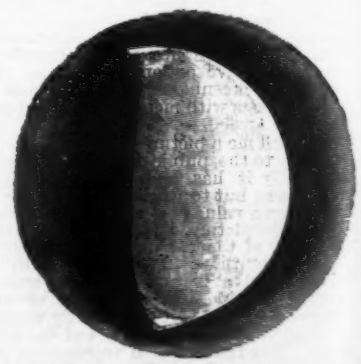


FIG. 7.—SHOWING IRREGULARITY OF TERMINATOR, NOVEMBER 23, 1877.

the horns (Fig. 8) also seem to be of common occurrence, and occasionally the curve of the terminator is perfect, no trace of any irregularity being noticed. Not only then does the terminator change in form, but changes are found to occur very rapidly in intervals of only a few hours. To take one case out of many, we may quote the instance recorded in 1881, on February 5, at 2 P. M. (Figs. 9 and 10). At this time the

terminator appeared as a straight line showing Venus then in apparent quadrature, but at 5 h. 43 m. this line was quite gibbous, and its curve regular. A very important point about the repetitions of the same deformations is that they do not occur at exactly the same

FIG. 8.—SHOWING INDENTATIONS AT THE HORNS, FEBRUARY 28, 1891.

time each day, but appear to change the hour of observation, "the periodicity of these phenomena, if periodicity there is, not being exactly twenty-four hours."

From a long series of observations, the most striking irregularities were found at the extremities of the terminator close to the edge of the pole caps, where deep

FIG. 9.—FEBRUARY 5, 2 H.

FIG. 10.—FEBRUARY 5, 5 H. 43 M.

niches were often recorded. These indentations were noticed to be generally of different sizes and shapes, sometimes the north one being larger than the southern one, and *vice versa*. They also underwent very rapid changes even in the space of a few hours, a case occurring on September 27, 1876 (Fig. 11). "At one time the extremity of one of the horns would be more

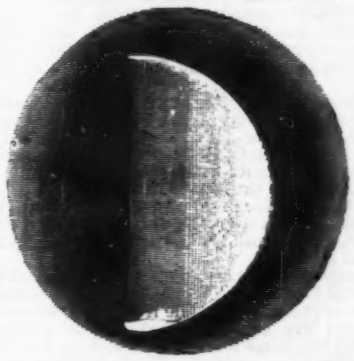


FIG. 11.—SHOWING THE SHAPE OF THE HORNS, SEPTEMBER 27, 1876.

or less truncated, when the other would be sharp, and some hours later the reverse would be the case, that which was sharp being truncated, and that which was truncated being sharp." M. Trouvelot concludes that his observations bring out a very important fact—"qu'il a une relation très étroite entre les déformations les plus importants subies par le terminateur et par les cornes, et les taches polaires de la planète."

When Venus approaches inferior conjunction with the sun, its crescent gradually diminishes until the illuminated surface is turned exactly away from us. Just before this position is reached, the crescent has been found to present many curious features. The most prominent of them is that this fine crescent is sometimes observed to extend to a greater angular extent than 180° (Fig. 12), 200° of the limb of the planet

FIG. 12.—AN ABNORMAL EXTENT OF THE CRESCENT, MAY 13, 1881.

having once been recorded. Sometimes, by adopting special precautions, the whole circumference has been observed, the obscured disk being completely surrounded by a pale and thin luminous ring. This, as M. Trouvelot says, is of very rare occurrence, for it has happened that although the greatest precautions have been taken, no trace of the planet could be found. When the crescent is extremely fine, great irregularities have been noticed to mar the continuity of its curve; they differ also not only at different but at the same conjunctions according as the planet is to the east or west of the sun.

Another fact that has been observed relates to the bulging out of the planet (Figs. 13 and 14) at some

FIG. 13.—SHOWING THE BULGING OUT OF THE CRESCENT AS SEEN ON FEBRUARY 24, 1878.

parts of its visible limb. This was especially noticed in the month of February, 1878; while the crescent was being looked at, the south-southeast portion seemed to suddenly appear thicker than the remaining part. In fact, the observer in the first instance thought it might have been due to some optical defect in the instrument; but subsequent observation showed that this was not the case, a real change of form having taken place. Two days later this deformation was still more noticeable, the thickness of the visible section

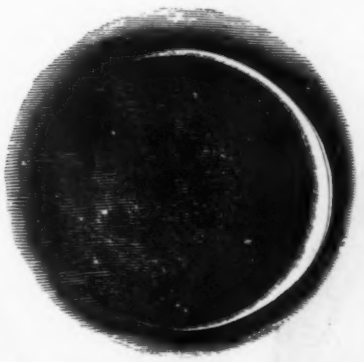


FIG. 14.—THE CRESCENT AS SEEN ON FEBRUARY 26, 1878.

being about double what it would have been had it been in its normal condition.

Perhaps one of the most important points referred to in this work is the determination of the period of rotation by means of the spots. This question of rotation is one that has baffled many observers, for the difficulty that has presented itself lies not only in the proper motions of the spots themselves, but in the identification of the same spots after brief periods of time. Glancing over some of the periods already obtained, we find that Schroeter deduced from his observations a rotation of about 24h., basing his value on the movement of a small isolated spot situated in one of the horns. Fritsch's value of 23h. 22m., and P. de Vico's 23h. 21m. 21s., are both also of about the same length. From observations by D. Cassini and F. Bianchini, we have a very wide deviation, the periods of rotation being reckoned in days, the former arriving at a value of 23 days and the latter at a somewhat larger one of 24 days 8 hours. Coming now to Schiaparelli's value of 225 days, we have here altogether a new departure, the planet rotating on its axis in the same time as it revolves round the sun.

With such values as these it will be at once seen that there is something radically wrong with the spots or their positions on the planet's surface; in some cases, of course, there might have been instances of mistaken identity, but with such an observer as Schiaparelli, who very definitely settles upon a 225 daily period obtained from direct observation, it is hard to conceive that any such sources of error would not have been remarked.

The observations which we have now before us bear out Schroeter's view of a short rotation, Prof. Trouvelot telling us that they were made during the years 1876–78 under exceptionally good conditions. One very interesting point which is of great importance is the fact that these observations were made at the same period, "souvent dans la même journée, sous un ciel également propice et précisément sur la même point de la planete."

The value nearest to 24 hours that Prof. Trouvelot obtained was 23h. 49m. 28s., and in giving this period he remarks that it is founded on the supposition that the spot had no proper motion. In referring to the period deduced by Schiaparelli he says, "La cause probable de l'erreur de M. Schiaparelli semble résulter de ce fait que les taches *h* et *k*, qui ont servi de base à ses conclusions, faisaient partie de la tache polaire méridionale qui, étant située centralement sur l'axe de rotation de la planete, semble rester stationnaire, comme cela se voit sur la tache polaire de Mars, quand elle se trouve réduite à de faibles dimensions." Taking into account many of the general features visible on the planet's surface, such as the rapid deformations of the horns and of the terminator, all these point to short periods of rotation, which, as Prof. Trouvelot points out, is "inconciliable avec la période de rotation, si lente et si inattendue, déduite par l'éminent astronome de Milan."

In concluding our remarks we cannot help mentioning the very complete way in which Prof. Trouvelot has taken into account the prior work in this interesting field of inquiry.—*W. J. L., Nature.*

ON THE SPECTRA AND PROPER MOTIONS OF STARS.*

By W. H. S. MONCK.

I HAVE more than once called the attention of the readers of *Astronomy and Astro-Physics* to the greater average proper motions of solar stars than those of the Sirian type, and I intimated my own opinion that this difference arose from the greater nearness of the solar stars. Solar stars, in my opinion, in consequence of their small relative brightness (or intrinsic brilliancy) become invisible at distances where the corresponding Sirian stars, though not, perhaps, of greater mass, can be clearly detected. It was, however, possible that the greater proper motions of the solar stars arose from their moving through space with greater velocity, and it, therefore, became important to ascertain as far as possible whether the spectroscope revealed any difference in their actual velocities. We have now a table of the spectroscopic velocities of fifty-one stars determined by Vogel which may be relied on as fairly accurate. The following is the result distinguishing Sirian from solar stars:

SIRIAN STARS.

	Type.	Velocity, Miles per Second.
α Andromedæ	A	+ 2·8
β Persei	A	− 1·0
γ Orionis	B	+ 5·7
β Tauri	A	+ 5·0
δ Orionis	B	+ 0·6
ε Orionis	A	+ 16·5
ζ Orionis	A	+ 9·3
β Aurigæ	A	− 17·5
γ Geminorum	A	− 10·3
Sirius	A ?	− 9·8
Castor	A	− 18·4
Regulus	A	− 5·7
β Ursæ Majoris	A	− 18·2
δ Leonis	A	− 8·9
β Leonis	A	− 7·6
γ Ursæ Majoris	A	− 16·5
ε Ursæ Majoris	A	− 18·8
Spica	A	− 9·2
ζ Ursæ Majoris	A	− 19·4
η Ursæ Majoris	A	− 16·3
β Libræ	A	− 6·0
α Coronæ Borealis	A	+ 19·9
α Ophiuchi	A	+ 11·9
Vega	A	− 9·5
Altair	A	− 22·9
α Cygni	A	− 5·0
α Pegasi	A	+ 0·8

SOLAR STARS.

	Type.	Velocity, Miles per Second.
β Cassiopeiæ	F	+ 3·2
α Cassiopeiæ	K	− 9·5
β Andromedæ	K ?	+ 7·0
Polaris	F ?	− 16·1
γ Andromedæ	K	− 8·0
α Arietis	K	− 9·2
α Persei	F	− 6·4
Aldebaran	K	+ 30·2
Capella	F	+ 15·2
Rigel	F	+ 10·2
Procyon	F	+ 5·7
Pollux	K ?	+ 0·7
γ Leonis	K	− 24·0
α Ursæ Majoris	K	− 7·2
Arcturus	K	− 4·8
ε Bootis	G ?	− 10·1
α Serpentis	K ?	+ 14·0
β Herculis	K	− 22·0
ε Pegasi	K	+ 5·0
β Ursæ Minoris	L ?	+ 8·9

Disregarding signs and taking the arithmetical mean, the average velocity of the Sirian stars is 10·8 miles per second and of the solar stars 10·9 miles per second. Vogel gives the average (including four stars with other spectra) as 10·4 miles per second.

Admitting that this result is not conclusive, I think, when taken in conjunction with the greater surface-brightness (this term is preferable to mass-brightness) of the Sirian binary stars whose orbits have been computed, we have strong reasons for concluding that Sirian stars are, on the average, much more distant than solar stars of the same magnitude, and that the reason why Sirian stars appear to be more numerous than the solars is that they are visible at distances where the corresponding solars are invisible with the same instruments. This conclusion may modify our opinions as to the structure of the universe. For instance, the theory sometimes adopted that the Galaxy consists chiefly of Sirian stars would be completely overthrown if we suppose that Sirian stars are, on the average, visible at double the distance of solar stars.

If the stars were motionless, the average velocity of 10 miles per second would mean that this was the average velocity with which the sun approached or receded from a point in the sky taken at random, and, although the stars are, no doubt, moving, the result may, in this respect, prove not far from the truth. Referring the sun's motion in space to three axes of coordinates at right angles to each other, we see that to give an average velocity of 10 miles per second to or from a given point, the velocity of the sun's motion in space must be $\sqrt{3} \times 10$ miles per second, or between 17 and 18 miles per second. An examination of Catalogues of Proper Motion has led me to think that the sun moves with at least this average velocity, and that

* Communicated by the author.

consequently its speed is not likely to be less than 18 miles per second. If we knew the exact direction of its motion, the corrected results of Vogel's observations would be very interesting. At present there is rather too much uncertainty for this.—*Astronomy and Astro-Physics.*

RESTORATIONS OF CLAOSAURUS AND CERATOSAURUS.

By O. C. MARSH.

A NUMBER of restorations of Dinosaurian reptiles have been recently made by the writer for the United States Geological Survey, and reduced figures of several of these have already appeared in this journal; namely, *Brontosaurus* and *Stegosaurus* from the Jurassic, and *Triceratops* from the Cretaceous.* Two others of interest are given in the present article; *Claosaurus* from the Cretaceous, and *Ceratosaurus* from the Jurassic, as shown on plates VI. and VII. The former is a gigantic herbivorous reptile, a typical member of the *Ornithopoda*, and the latter a large carnivorous form of the *Theropoda*, as these orders have been defined by the writer.† Each of these two reptiles is a characteristic example of the great order in which it belongs, but both are highly specialized, and present many features not seen in earlier and more primitive types. Their representatives in the old world are *Iguanodon* and *Megalosaurus*, although each of the four genera may represent a distinct family.

It is especially fortunate that each of the restorations here presented is based upon the remains of a single individual in which both the skull and skeleton were found in position, and in remarkable preservation. Additional remains, apparently identical with each, have also been secured, and these have cleared up several points which otherwise might have been left in doubt. These various remains have already been described by the writer, and the most important parts figured.

RESTORATION OF CLAOSAURUS ANNECTENS, Marsh. (One-fortieth natural size.)

Claosaurus, Marsh, 1890.‡

The most important feature in the restoration of *Claosaurus annectens* given on plate VI. is the skull, which will be fully described elsewhere, but its main features may be noticed here. This skull is long and narrow, with the facial portion especially produced. The anterior part is only moderately expanded transversely, thus differing from that of *Hadrosaurus* (*Diclonius*), a nearly allied form. Seen from the side the skull of *Claosaurus* shows a blunt, rugose muzzle formed above by the premaxillary and below by the predentary, both probably covered in life with a thick, corneous integument.

Behind the upper part of this muzzle is an enormous lateral cavity, which includes the narial orifice, but was evidently occupied in life mainly by a nasal gland, somewhat like that in the existing monitor, and also seen in some birds. This cavity is bounded externally by the nasal bone and the premaxillary. The orbit is very large, and subtriangular in outline. It is formed above by the prefrontal, frontal, and postfrontal, and below mainly by the jugal. There are no supra-orbital bones. A distinct lachrymal forms a portion of the anterior border. The infra-temporal fossa is large, and bounded below by the jugal. There is a thin quadrato-jugal between the jugal and quadrate. The occipital condyle is directed backward and downward.

The nasals are very long and slender, and in front are separated by the narrow superior processes of the premaxillaries. The frontals are short and broad, and somewhat concave above. The parietals are firmly co-ossified, and very small, forming a thin partition between the supra-temporal fossæ. The latter are bounded posteriorly by the massive squamosals, which contain a deep cavity for the head of the quadrate, and also overlap the exoccipitals.

The striking features of the lower jaw are the massive, rugose predentary, the large and powerful dentary bone with its robust coronoid process, and the very small angular and articular bones.

The teeth are confined entirely to the maxillary and dentary bones. They closely resemble those of *Hadrosaurus*, are arranged in the same manner, and appear to be equally numerous.* They were well adapted to a diet of soft succulent vegetation.

The main characters of the vertebral column of *Claosaurus* are well shown in the restoration. There are thirty vertebræ between the skull and sacrum, nine in the sacrum, and about sixty in the tail. The whole vertebral column was found in position except the terminal caudals, which are here represented in outline. The cervical vertebræ are strongly opisthocœlian, and the first eleven have short ribs. The dorsals are also opisthocœlian. There are no true lumbar vertebræ, as the last of those in front of the sacrum support free ribs. The anterior caudals are opisthocœlian. The first and second have no chevrons. Behind these, the chevron bones are very long, indicating a powerful compressed tail, well adapted for swimming.

In the median dorsal region, between the ribs and the neural spines, are numerous rod-like ossified tendons, which increase in number in the sacral region and along the base of the tail, and then gradually diminish in number and size, ending at about the thirty-fifth caudal. These ossified tendons are well shown in the restoration, and are of much interest. They are not unlike those in *Iguanodon* described by Dollo, but as a rule are more elongate, and appear to lack the definite arrangement in rhombodial figures observed in that genus.†

The fore limbs are unusually small in comparison with the posterior, and the relative size of the two is well shown in the restoration. The scapular arch presents many points of interest. The scapula is large, and so much curved that its shaft is nearly at right angles to the articular faces of its lower extremity. On the anterior margin, above the articulation for the coracoid, is a strong protuberance, with a well defined facet, adapted to the support of the clavicle, if such a bone were present. The coracoid is very small, and is perforated by a large foramen. The two peculiar bones now generally regarded as belonging to the sternum were not co-ossified.

The humerus is comparatively short. The radius and ulna are much elongated, the latter being longer than the humerus, and the radius about the same length. The ulna has a prominent olecranon process, and is a stouter bone than the radius. The carpal bones were quite short, and appear to have been only imperfectly ossified. The fore foot, or manus, was very long and contained three function digits only. The first digit was rudimentary, the second and third were nearly equal in length, the fourth was shorter and less developed, and the fifth entirely wanting, as shown in plate VI.

In the functional digits (II, III, IV), the phalanges are elongate, thus materially lengthening the fore foot. The terminal phalanges of these digits are broad and flat, showing that they were covered with hoofs, and not with claws. The limb as a whole was thus adapted to locomotion or support, and not at all for prehension, although this might have been expected from its small size and position.

The elongation of the fore arm and manus is a peculiar feature, especially when taken in connection with the ungulate phalanges. It may, perhaps, be explained by supposing that the animal gradually assumed a more erect position until it became essentially a biped, while the fore limbs retained in a measure their primitive function, and did not become prehensile, which was the case in some allied forms.

The pelvis has already been described by the writer. Its most notable features are seen in the pubis and ischium, the former having a very large expanded prepubis with the postpubis rudimentary, while the shaft of the ischium is greatly elongated.

The femur is long, and the shaft nearly straight. The great trochanter is well developed, while the third trochanter is large and near the middle of the shaft. The external condyle of the distal end is projected well backward, indicating great freedom of motion at the knee.

The tibia is shorter than the femur, and has a prominent cnemial crest. The distal end is much flattened, and the astragalus is closely adapted to it. The fibula is very straight, with its lower end flattened and closely applied to the front of the tibia. The calcaneum is large, with its concave upper surface closely fitted to the end of the fibula. Of the second row of tarsals, only a single one appears to be ossified, and that is very small and thin, and placed between the calcaneum and the fourth metatarsal, nearly or quite out of sight.

The hind foot, or pes, had but three digits, the second, third, and fourth, all well developed and massive. The terminal phalanges were covered with broad hoofs. The first and fifth digits were entirely wanting.

All the limb bones in *Claosaurus* are solid, thus distinguishing it from *Hadrosaurus*. The separate ischium, not co-ossified with the pubis, the absence of a fourth digit in the hind foot, and other marked characters, also make the genus distinct from *Pteropelyx*, the skull of which is not known.

The reptile here restored was nearly thirty feet in length when alive, and about fifteen in height in the position represented in plate VI. The remains were obtained by Mr. J. B. Hatcher and Mr. A. L. Sullins in the Ceratops beds of the Laramie, in Wyoming. Among the associated fossils are the gigantic *Triceratops* and *Torosaurus*, which were also herbivorous Dinosaurs, and with them were found the diminutive Cretaceous mammals recently described by the writer.

Ceratosaurus, Marsh, 1884.*

In the same horizon of the Jurassic in which *Brontosaurus* and *Stegosaurus* were found, the skeleton restored in plate VII. was likewise discovered. It is a typical carnivorous Dinosaur of moderate size, and doubtless was one of the various enemies of the large herbivorous forms. The restoration represents the reptile one-thirtieth natural size, and in a position it must have frequently assumed.

The skull of *Ceratosaurus nasicornis* is very large in proportion to the rest of the skeleton. The posterior region is elevated, and moderately expanded transversely. The facial portion is elongate, and tapers gradually to the muzzle. Seen from above, the skull resembles in general outline that of a crocodile. The nasal openings are separate and lateral, and are placed near the end of the snout, as shown in plate VII.

Seen from the side, this skull appears Lacertilian in type, the general structure being light and open. From this point of view, one special feature of the skull is the large, elevated, trenchant horn core situated on the nasals. Another feature is the large openings on the side of the skull, four in number. The first of these is the anterior nasal orifice; the second, the very large triangular antorbital foramen; the third, the large oval orbit; and the fourth, the still larger lower temporal opening.

The parietal bones are of moderate size, and there is no parietal foramen. The median suture between the parietals is obliterated. The frontal bones are rather short, and are closely united on the median line. The nasal bones are more elongate than the frontals, and are firmly co-ossified. These bones support the large, compressed, elevated horn core, on the median line. The lateral surface of this elevation is very rugose, and furrowed with vascular grooves. It evidently supported a high, trenchant horn, which must have formed a most powerful weapon for offense and defense.

The premaxillaries are separate, and each contained three functional teeth. The maxillary bones are large and massive, as shown in plate VII. They are provided each with fifteen functional teeth, which are large, powerful, and trenchant, indicating clearly the ferocious character of the animal when alive. These teeth have the same general form as those of *Megalosaurus*, and the dental succession appears to be quite the same. Above the antorbital foramen on either side is a high elevation composed of the prefrontal bones. These protuberances would be of service in protecting the orbit, which they partially overhang.

The lower jaws of *Ceratosaurus* are large and powerful, especially in the posterior part. In front, the rami are much compressed, and they were joined together by cartilage only. There were fifteen teeth in each ramus, similar in form to those of the upper jaws.

The cervical vetebræ of *Ceratosaurus* differ in type from those in any other known reptiles. With the exception of the atlas, all are strongly opisthocœlian, the cup on the posterior end of each centrum being unusually deep. In place of an equally developed ball on the anterior end, there is a perfectly flat surface. The size of the latter is such that it can only be inserted a short distance in the adjoining cup. This peculiar articulation leaves more than three-fourths of the cup unoccupied by the succeeding vetebra, forming, apparently, a weak joint.

The dorsal and lumbar vertebræ are bi-concave, with only moderate concavities. The sides and lower surface of the centra are deeply excavated, except at the ends. All the presacral vertebræ are very hollow, and this is also true of the anterior caudals.

There are five well co-ossified vertebræ in the sacrum of the present specimen of *Ceratosaurus nasicornis*. The transverse processes are very short, each supported by two vertebræ, and they do not meet at their distal ends. The caudal vertebræ are bi-concave. All

* *Amer. Jour. Sci.*, xli, p. 339, April, 1891; and vol. xlii, p. 179, August, 1891.

† Ibid., vol. xxi, p. 423, May, 1881; and vol. xxiii, p. 84, January, 1882.

‡ *Amer. Jour. Sci.*, vol. xxxix, p. 423, May, 1890; vol. xliii, p. 453, May, 1892; and vol. xliv, p. 171, August, 1892.

* The description given by Cope of the skull of *Hadrosaurus* (*Diclonius*) *mirabilis*, Leidy, is erroneous in various important points. Among the more serious errors are the following: the predentary bone is mistaken for the dentary, the dentary is regarded as the surangular and as the splenial, while the squamosal is called the parietal. See Proc. Phil. Acad., 1883, p. 97, plates iv—vii.

† Archives de Biologie, tome vii, p. 249, Gand, 1886.

* *Am. Jour. Sci.*, vol. xxvii, p. 339, April, 1884; and vol. xxviii, p. 161, August, 1884.

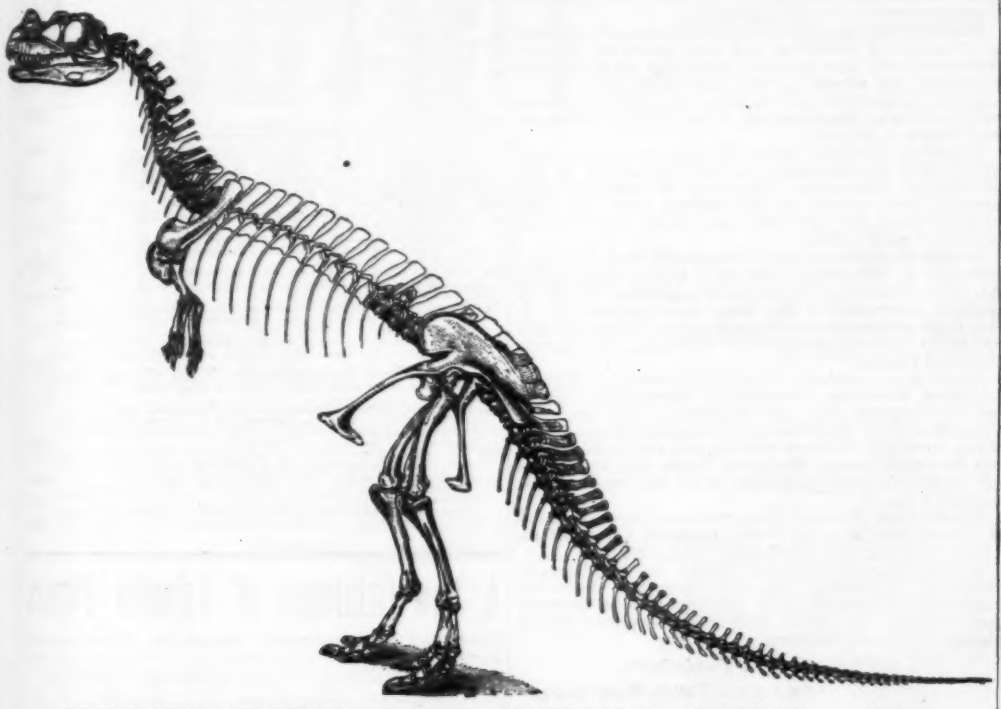
the anterior caudals, except the first, supported very long chevrons, indicating a high, thin tail, well adapted to swimming. The tail was quite long, and the distal caudals were very short.

The scapular arch of *Ceratosaurus* is of moderate size, but the fore limbs are very small. The humerus is short, with a strong radial crest. The radius and ulna are also very short, and nearly equal in size. The carpal bones were only imperfectly ossified. There were four digits in the fore foot, and all were armed with sharp claws. The second and third digits were much larger than the first and fourth, and the fifth was entirely wanting.

The pelvic arch of *Ceratosaurus* is of special interest. In the type specimen here restored, the ilium, ischium, and pubis, on each side, are firmly co-ossified. The ilia, moreover, are attached to the sacrum, which was in place in the skeleton. The ilia have the same general form as in *Megalosaurus*. The ischia are comparatively slender. They project well backward, and for the last half of their length the two are in close apposition. Their distal ends are co-ossified and expanded, as shown in plate VII.

The pubes have their distal ends co-ossified, and expand into an elongate, massive foot, which is one of the most characteristic parts of the skeleton. It is probable that this foot in connection with the distal ends of the ischia served to support the body in sitting down. That some Triassic Dinosaurs sat down on their ischia is proved conclusively by the impressions in the Connecticut River sandstone. In such cases the leg was bent so as to bring the heel to the ground. The same action in the present reptile would bring the foot of the pubes to the ground, nearly or quite under the center of gravity of the animal. The legs and ischia would then naturally aid in keeping the body balanced. Possibly this position was assumed habitually by these ferocious biped reptiles, in lying in wait for their prey.

The femur is much curved, and the shaft very hollow. The tibia is shorter than the femur, nearly



RESTORATION OF CERATOSAURUS NASICORNIS, Marsh. (One-thirtieth natural size.)

straight, and has a large enemial crest. The astragalus is not co-ossified with the tibia, and has a strong ascending process. The fibula is well developed, and nearly straight, its distal end fitting into the calcaneum. The tarsals of the second row are very thin, and united to the metatarsals below them.

The most interesting feature in the extremities of this Dinosaur is in the metatarsal bones, which are completely ankylosed, as are the bones of the pelvis. There are only three metatarsal elements in each foot, the first and fifth having apparently disappeared entirely. The three metatarsals remaining, which are the second, third, and fourth, are proportionally shorter and more robust than in the other known members of the *Theropoda*, and being firmly united to each other, they furnish the basis for a very strong hind foot. The phalanges of the hind feet are of moderate length, and most of them are quite hollow. The terminal phalanges evidently supported strong and sharp claws.

The unique cervical vertebræ, the co-ossification of the pelvic bones, and the union of the metatarsals, as in modern birds, distinguish *Ceratosaurus* widely from all other Dinosaurs, and make it the type of a well-marked family, the *Ceratosauridæ*. The nearest allied form is apparently *Ornithomimus*, from the Laramie, recently described by the writer.

The type specimen of *Ceratosaurus* was about twenty-two feet long when alive, and twelve feet high as here restored. It was found by Mr. M. P. Felch, in the Atlantosaurus beds of the upper Jurassic in Colorado. The associated fossils were mainly other Dinosaurs, especially *Sauropoda* and *Ornithopoda*, together with various small mammals.

PNEUMONIA TREATED BY ICE COLD APPLICATIONS.

By Dr. W. FRED. JACKSON, Brockville, Ontario.

THE poet who sings of the beauties of spring seeks his inspiration while the earth is still in the lap of winter. So the practitioner of the healing art, in order to be prepared for the prevailing ailments of the colder seasons, must do a little thinking about it during the warmer months, and perhaps draw somewhat upon the last winter's experience of himself and others.

The fact that so many and various treatments are advised for pneumonia shows either that a really feasible and successful treatment is not generally recognized or that, as Dr. Osler tells us, the disease is practically uninfluenced for good by any treatment whatever, beyond general principles.

Upon the clear recognition of the morbid processes at work in the system, causing pneumonia and its series of phenomena, must rest the formulation of a rational and successful line of treatment for this disease.

The war which has raged about the treatment of this prevalent and often very fatal complaint has seen the banners of venesection, antimony, squills, opium, ammonia, alcohol, heat and cold, expectancy and heroism, with many others of lesser following, scour the field in serried array, with many ups and downs, in the fight for favor at the hands of the profession. And latterly, the coal tar derivatives, with their specious promises of cooling the fevered brow, have won for the time a position in which strategy has had more effect than solid fighting capacity.

That pneumonia *is a specific fever*, in which the lesion of the pulmonary tissue is but an incident, is not I believe sufficiently recognized. Upon this one fact rests, I am firmly convinced, the rational and successful treatment of this, which is pre-eminently *the* disease of our colder months.

In all cases the general febrile condition is initiated and in full progress in advance of the lung lesion. The prompt recognition of the morbid process at work renders possible the aborting of the pulmonary sequence. I have seen and recognized the pneumonic fever in progress a full week before the characteristic signs appeared in the lung, and I have no doubt most readers have had a similar experience. The pulmonic fever itself would rarely promote a fatal result; and I feel safe in saying that, just so far as the invasion of the lung substance (and the consequent interference with the action of a vital organ) is prevented, by so much will a fatal event in this disease be averted.

Another fact is to be borne in mind in the treatment of this and other febrile diseases, viz., that in fever there is lessened elimination of heat, as well as increased production of it. And also that, in increased temperature of the human body, the morbific germs become more active in their growth and multiplication the higher the point indicated by the mercury. I think the inference is obvious.

Influenced by the foregoing considerations, I decided last winter to adopt the use of cold applications in the treatment of pneumonia. This decision was strengthened by confirmatory evidence, which I observed in the current medical literature.

During the past winter I treated about twenty-five cases of pneumonia upon practically this one line of procedure. The results were excellent in every way. The recoveries were prompt and rapid in all the cases but two. Of these, one was very prolonged, being secondary to la grippe and complicated with fibrinous pleurisy, and the other died. The latter was a hospital case—a poor, miserable woman, who had led a wretched life. There was albuminuria, due—as post mortem examination revealed—to cystic degeneration of the kidneys, and also concurrent peritonitis. So I do not think that any treatment whatever would have altered the result. I do not propose to go into statistics, for my cases are too few. But the beneficial effects of the treatment were so prompt and so apparent, *in the face of the greatest prejudice and opposition*, that they carried conviction to the most unbelieving. I have seen the application of ice-cold compresses terminate a case of double pneumonia of the base by crisis in sixty hours. This case was characterized by severe dyspnœa, pain, and a temperature of over 105° F., with total absence of breath sounds at the bases when first seen.

Another patient, a woman of 74 years, with consolidation of right base, recovered in four days.

A baby, two years of age, with catarrhal pneumonia, most marked on the left side, was quite convalescent on the third day.

A laborer, 34 years of age, with consolidation of right base, delirious, and much oppressed for breath, required but two days' attendance.

A bride, 23 years of age, who had been undergoing the usual round of festivities, awoke, after a particularly fatiguing party, in a feverish and lethargic state. Called immediately, I stated the probability of pneumonia ensuing. After twenty-four hours there was the characteristic fine crepitation and stitchy feeling to the breathing; temperature, 105½° F.; pulse, 130. Ice-cold compresses aborted the lung lesion entirely, and produced a critical perspiration in thirty hours, at which time the norm was reached and persisted.

There is no need to enlarge these details. The cases are all down in my case-book, and they all bear the record that from the time the cold was applied rapid improvement ensued.

The method was as follows: A large towel was wrung out of ice water, and the thorax enveloped in it. A comparatively dry towel was laid over it, and a binder of flannel or cotton held all snug. The ice-water towel was changed as often as necessary, in order to ease the pain and reduce the temperature. When the pain or dyspnœa was severe, or the temperature high, the intervals would be short, say five or ten minutes. As the symptoms improved, the changes were made only as the towels assumed the heat of the body. The face and limbs were frequently sponged with the ice water, and when required a cold compress was put upon the brow.

The medication was confined to promoting a critical perspiration. This was effected by large doses of liquor ammonii acetatis and spiritus etheris nitrosi, well diluted, every hour. In one or two cases this had to be supplemented with pilocarpine muriate. No alcohol was required, except in the fatal case referred to. Antipyretics of the coal tar series were not used, except in the one case just mentioned. The diet was principally of milk, and liberal in quantity. Incidental symptoms were met as they arose. In none of the cases was there any expectoration to mention. In some none at all, in others but a little. Free perspiration was usually succeeded by copious diuresis. As a precautionary measure, a wet compress was worn for twenty-four hours after the crisis, and changed when it became dry.

In order to obtain the effects to be desired in this treatment, the cold must be freely applied and with a firm hand, until the effect of a reduction of temperature and arrest of symptoms occurs.

The treatment is grateful to the patient. It can be managed without incommoding the sufferer, by the exercise of a little ingenuity. It is prompt in its effects for good, and it is easily applied.

In exceedingly plethoric cases I could conceive of the value of venesection at the outset, and, in fact, have so used it with excellent effect, but not in the series under consideration.

As the experience of twenty years' continued observation, I would most earnestly deprecate the use of opium, antimony, or blisters in the treatment of pneumonia, and my experience of the more modern antipyretics is hardly more favorable.

Under the usual routine treatment of poultices, expectorants, and whisky, I can quite understand Dr. Osler's view as to the non-efficiency of treatment. But with the experience of the free use of cold, in the manner herein outlined, and in view of the etiological considerations advanced, I feel that a new and happier era is dawning in the treatment of pneumonia.—*Therapeutic Gazette.*

ACID DISTILLED WATER.

THIS apparent anomaly has recently been found by Dr. E. Gudeman, who communicated his phenomenal experience in a paper read before the American Chemical Society. It appears that the water supply of the city of Buffalo is taken from the Niagara River, about one mile from its source, Lake Erie. The inlet where the water is drawn is about one-quarter of a mile from the shore, and the river at that point has a six to eight mile current.

The water is generally clear, but after every severe rain storm, or from high winds, it becomes turbid, and then contains quite an amount of suspended matter, which filtration will separate.

The water contains, per United States gallon, from eleven to fifteen grains of total solids, five to eight grains being organic. The inorganic portion consists mainly of calcium carbonate and sulphate.

From December, 1891, to August, 1892, the water as taken from the mains gave an absolutely neutral reaction. During August a sudden change took place, the water becoming alkaline. The amount of alkalinity varies; 100 c. c. of water being sufficient to neutralize from 0·05—0·3 c. c. of half normal sulphuric acid. The water gives a strong reaction for carbonic acid, and this reaction is, without doubt, due to the calcium bicarbonate contained in the water. The water loses this alkaline reaction by filtration through animal charcoal.

The distilled water made from the Niagara River water gives a distinct *acid* reaction.

The acid in 100 c. cm. of the distilled water will neutralize from 0·01—0·05 c. c. of half normal caustic potash solution.

The water before being distilled was made alkaline with caustic soda, sodium carbonate, caustic baryta, and barium carbonate, still the distillate gave the same acid reaction as the original untreated water. The water was made acid with sulphuric acid without any effect on the distillate. Potassium permanganate also gave no better results. The water was filtered through animal charcoal, then distilled, without any effect on the acidity of the distillate.

The amount of acidity varies constantly, but, so far, has always come within the above mentioned limits, the average being about 0·15 c. c. of semi-normal potash solution to 100 c. c. of distilled water.

It makes no difference whether the distillation is carried on in copper or glass retorts; whether the heat is applied by means of steam coils or Bunsen burners.

The separate portions from the same distillation show no marked difference in acidity, the first 100 c. c. of distillate neutralizing as much potash solution as the last. The water remaining in the retort gives the same reaction, neutral or alkaline, as the original

water. This would tend to show that the acid is not contained in the water as such, but is a product of decomposition, continuously formed during ebullition.

The distilled water gave no reaction for carbonic acid and leaves absolutely no residue on evaporation. It reacts acid to solutions of litmus, lacmoid and alkaline phenolphthalein.

The water can easily be purified from this acid body by boiling off about one-fourth of this bulk, when the remainder will be neutral. A second distillation after having made the water alkaline with sodium carbonate also gives a neutral distillate.

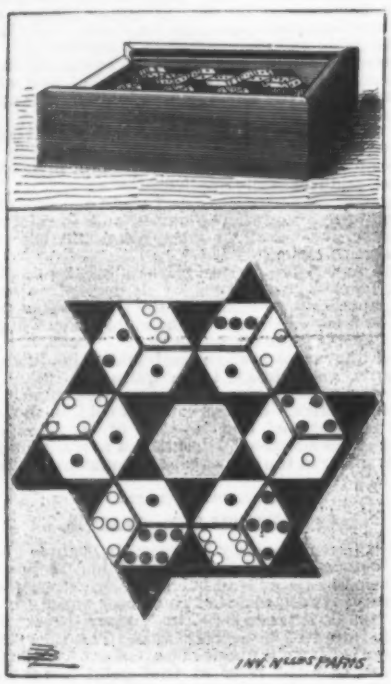
To be absolutely certain that this acid reaction was not due to some local contamination, Dr. Gudeman requested Prof. H. M. Hill, of the University of Buffalo, and Dr. J. A. Miller, of the Niagara University, to test the water as delivered at their respective laboratories, the one being about one mile and the other about two miles from his laboratory, and all supplied from different water mains. Both gentlemen obtained the characteristic acid reaction from their distilled waters.

These tests were begun in December, 1891, and are still being carried on.

JAPANESE DOMINOES.

THE Japanese game of dominoes, in the form of the pieces, in their composition, and especially in the variety of their combinations, differs sensibly from the ordinary game, and therefore merits a description. The pieces, which are 56 in number, are triangular, and carry, inlaid, a hexagon of bone, ivory, or mother-of-pearl, even with the sides, and simulating a die of which three faces are seen at the same time. Each piece includes three points of different color, black, red, and yellow, and in each shade there are counted 6 aces, 6 deuces, 6 trays, 6 fours, 6 fives, and 6 sixes. Each piece has its own proper value determined by the black points, which are the tens, and by the reds, which are the units. Thus the three black and four red equal 34.

The number of players is optional. Each one selects



JAPANESE DOMINOES.

six pieces. The game begins by the highest domino raised, according to its proper value. Red is played upon red and black upon black. The yellows are not played upon; but if one plays a piece superior in yellow point to that that it covers, he can play again on one side or the other of the line until the yellow point played is inferior to the preceding.

The player who draws from the stock can take but a single piece at each turn. He cannot resort to the stock when the game is closed; that is to say, when the six pieces that carry the point demanded are already placed. He who has closed the game may reopen it, if he finds it of interest to do so, by moving a domino from one end of the line to the other. The game is won by the one who holds the fewest pieces in case of a definitive stoppage of the playing. With an equal number of pieces, it belongs to the one who stopped the game. The last piece played expresses the points won. If it is 43, for example, the game is tantamount to 43 points.—*Les Inventions Nouvelles.*

HOW TO DO UP A HORSE'S TAIL.

THE necessity of taking horses out in all kinds of weather, and in every kind of footing, exists almost as strongly in the sewing machine as in any other business. Rubber covers protect the machine and the animal's head, shoulders and body, but how about its tail? If it be a long and handsome one, the more likely is it to become defiled by mud or slush. It is then that the knowledge how to do it up in proper shape can be well applied. The following directions are from one of our exchanges, and are plain enough to need no further comment.

"First, take the tail in the left hand; with the right hand take hold at the upper end of a small bunch of hair about eight or ten inches long; then select another bunch of the very longest hair in the tail, about the size of a man's finger. With both hands twist what is left in the left hand three or four times to the right, then with the right hand put it under and catch it with the left hand, and hold it till you take the long bunch of braid with the right hand and twist around, or wind around once or twice, according to the length of the hair, from the opposite direction. Then take the end of it with what you have in your left hand and the short bunch; twist all together in a hard twist, double it and find the band of the braid that you wound around the tail, and stick it under twice. After a little practice any farmer, who will carefully observe the above rule, can do up his horse's tail anywhere, on the road or in the stable, in two or three minutes, without strings or ribbons, and it will stay till taken down. I have never seen or heard of a better and quicker way. I got it from a French stage driver."—*The Hub.*

THE ALUMINUM BICYCLE.—A well-known manufacturer of Paris has been experimenting with aluminum in the production of bicycles. In order to make it applicable, it was found necessary to alloy it with copper, as it can only be used in its pure state for guards and cranks, where its extreme lightness gives a distinct advantage over steel.

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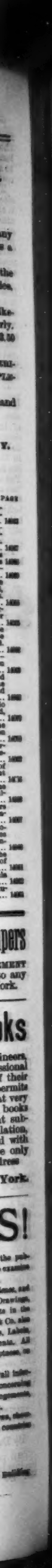
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